4. NATURE AND EXTENT OF CONTAMINATION

This section summarizes investigations conducted to determine the nature and extent of the contamination at each of the retained sites for the Waste Area Group (WAG) 1 Comprehensive Remedial Investigation Baseline Risk Assessment (RI/BRA). Information detailing the release mechanism responsible for the contamination, detected contaminants, and the source-term estimates for the Baseline Risk Assessment (BRA) are presented. The data used to identify contaminants and calculate source term concentrations are summarized in Appendix B Tables B-3 through B-29 and presented in Appendix B.

4.1 Summaries of Retained Sites

As presented in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan, a site-screening process was employed to identify those sites with known contamination for inclusion in this RI/BRA. Based on this process, agency comments and resolution, the following sites were retained: Technical Support Facility (TSF)-11, TSF-03, Water Research Reactor Test Facility (WRRTF)-01, TSF-29, TSF-06, TSF-09/-18, TSF-10, TSF-21, TSF-26, TSF-07, TSF-05/-23, TSF-22, WRRTF-05, WRRTF-13, TSF-36, TSF-37, TSF-27, Loss-of-Fluid Test Facility (LOFT)-12, TSF-08 (Site 13B), TSF-38, and WRRTF-04.

At each of these retained sites, a contaminant screening process was used to identify contaminants that have the potential for causing adverse human health and ecological impacts. The screening process employed a comparison of maximum concentration to background concentration and essential nutrient identification, a concentration-toxicity screen, and a comparison of maximum concentration to risk-based concentration. Section 6.2 describes the site and contaminant screening process in detail. The evaluation of each of the screening steps for each chemical at each site is shown on Appendix B Tables B-3 through B-29. The following retained sites were found to contain no contaminants of potential concern (COPCs) and were not evaluated quantitatively in the BRA: TSF-27, TSF-38, WRRTF-04, and WRRTF-13.

Additionally, sites Initial Engine Test (IET)-04 and TSF-06 Area 10, only contain buried material with fixed surface contamination. This fixed contamination is considered to be inaccessible to human and ecological receptors at the sites; therefore, the sites are only discussed in the BRA and ecological risk assessment (ERA) uncertainty sections (see Sections 6.6 and 7). As summarized in the Preliminary Scoping Track 2 Summary Report for Test Area North (TAN) Operable Unit (OU) 1-05, IET-04 has not released contamination to the environment. For IET-04, all the loose contamination was removed prior to decontamination and decommissioning (D&D) and the stack was covered with a 3 to 4.6 m (10 to 15 ft) soil cover. Section 4.1.9.4 discusses TSF-06, Area 10.

The data used to define nature and extent of contamination at the sites identified above are from the WAG 1 Track 1 and Track 2 investigations, the OU 1-07A RI/FS, the OU 10-06 Removal Action, and the OU 1-10 remedial investigation (RI). Detailed information used in developing the following nature and extent summaries for these sites can be found in the above-referenced documents and Section 3 of this RI/BRA in which the data collected during the OU 1-10 RI is presented. The data collected during these investigations did not remove all uncertainty associated with the nature and extent of contamination at retained WAG 1 sites. However, in conjunction with conservative assumptions regarding nature and extent of contamination the data are sufficient to provide conservative source term estimates for the performance of the BRA and evaluate remedial alternatives in the feasibility study (FS). Assumptions utilized are detailed in the site summaries and nature and extent of contamination sections.

4.1.1 OU 1-01: TSF-11, Three Clarifier Pits East of TAN-604

4.1.1.1 Site Summary. The TSF-11 clarifier pits, which have been removed, were formerly located approximately 0.9 m (3 ft) east of building TAN-604 as shown in Figure 4-1. The clarifier pits consisted of three concrete basins inside a concrete tank with a total combined capacity of approximately 3,175 L (840 gal). The overall tank dimensions were 1.2 m wide by 3 m long by 2.1 m deep (4 by 10 by 7 ft). The top of the clarifier pits was located at the ground surface, and each pit had a metal manhole cover to allow access.

The clarifier pits were connected, via a steel line, to a service sink in the paint room located at the east end of building TAN-604. It is believed that the clarifier pits received wastewaters containing paint and paint thinners from the paint room between 1957 and 1985. Waste to the clarifier pits entered the northern pit (Pit No. 1) and flowed through the middle pit (Pit No. 2) and southern pit (Pit No. 3) before entering the steel outlet line that carried the waste to the TSF sanitary treatment system. As waste moved through the clarifier pits, suspended solids settled out into the gravel layer at the bottom of each pit.

4.1.1.2 Previous Investigations. Between 1987 and 1994 sludge and residual liquids were sampled for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, and alpha-, beta-, and gamma-emitting radionuclides. Nine VOCs, eight SVOCs, one herbicide, and one polychlorinated biphenyl (PCB) (aroclor-1260) were detected at low concentrations in 1987 and 1989. The concentrations of metals and inorganics in the samples ranged from nondetectable (antimony, beryllium, cyanide, selenium, thallium, and tin) to 3,370 ppm zinc. In 1989 the liquid samples exceeded the extraction procedure regulatory levels for mercury; however, following a solids analysis, no toxicity characterization leaching procedure (TCLP) inorganic constituents were detected above regulatory limits.

Results from the gamma spectrometry showed that Cs-137 was the only gamma-emitting radionuclide detected with a maximum concentration of 0.13 ± 0.03 pCi/g. Uranium isotopes and Am-241 were detected in all of the samples, with the exception of U-235, which was not detected in the water sample. Maximum concentrations detected were 67 ± 2 pCi/g, 9.5 ± 0.6 pCi/g, 330 ± 5 pCi/g, and 0.21 ± 0.05 pCi/g for U-234, U-235, U-238, and Am-241, respectively. Plutonium isotopes, Sr-90, and H-3 were not detected in any of the samples.

Given the operational history, the contaminants detected are consistent with those that would be expected from a paint shop at a nuclear site. The source of the manmade radionuclides present are thought to be from occasional cleaning of paint brushes used to paint objects with fixed radioactive contamination.

Remediation of the tank and clarifier pits began in May 1994. Approximately 530 L (140 gal) of liquid and 227 L (60 gal) of sludge were removed from the pits and disposed at the Radioactive Waste Management Complex (RWMC). After removing a majority of the sludge, the soil surrounding the tank was excavated and the tank was removed. No evidence of leakage or contamination was observed on the outside of the tank, in the soil excavated from around the tank, or in the 2.1-m (7-ft) deep excavation itself. The tank surface was monitored for VOCs (with a HNu) and for beta/gamma contamination, using a Ludlum 2A instrument during removal. No VOCs nor radiation above normal area background levels were detected. The tank was then decontaminated and disposed of at the Central Facilities Area (CFA) Landfill.

Three verification soil samples were collected from the bed of the excavation at 2.1 m (7 ft) belowground surface (bgs) (see Figure 4-1). Sampling involved scraping a small amount of soil from the excavation floor with the backhoe bucket. After verification soil samples were collected, the excavation was backfilled with soil removed from the excavation and gravel, and new asphalt was laid in the area.

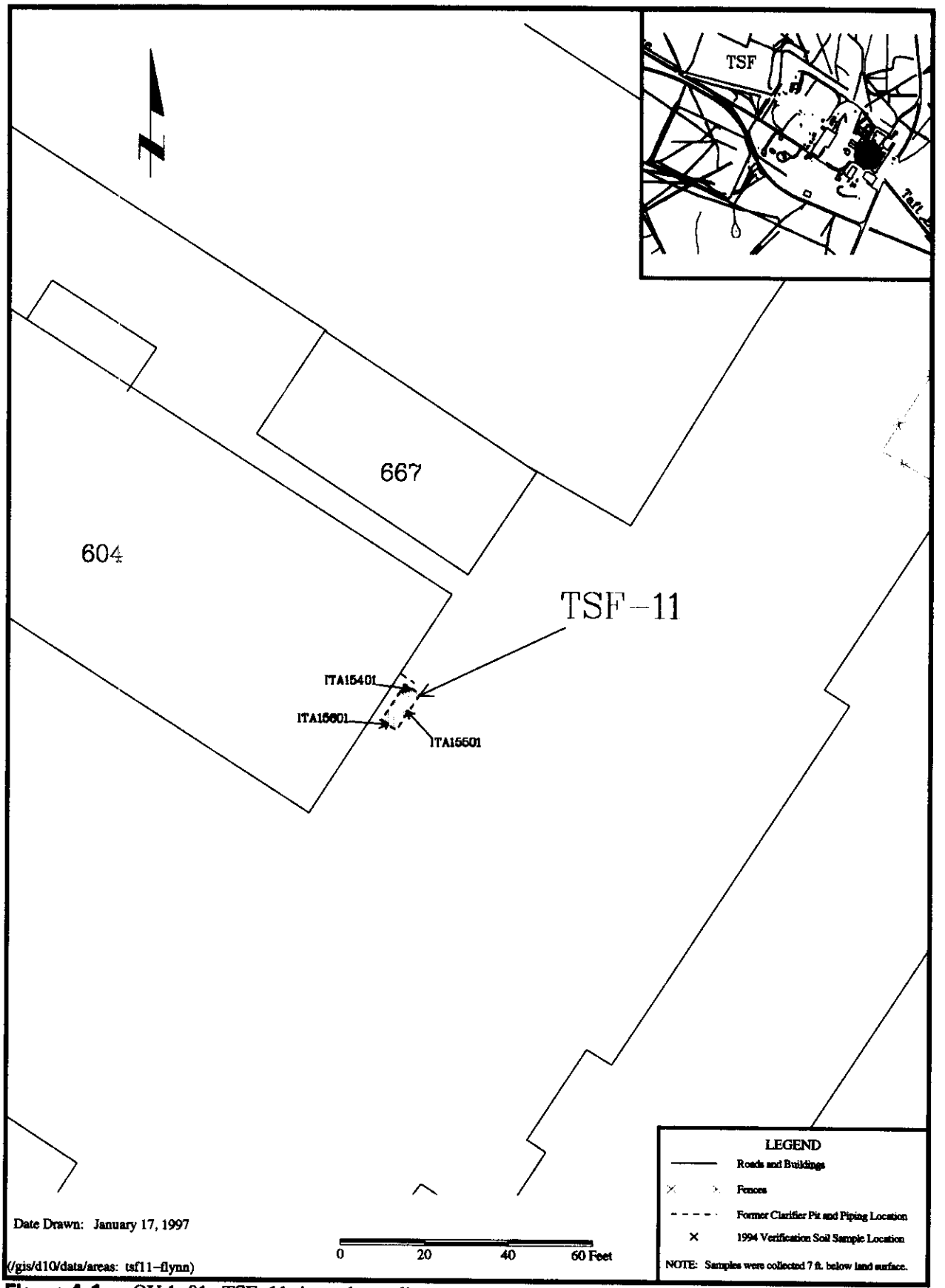


Figure 4-1. OU 1–01: TSF–11 site and sampling map.

The verification samples were analyzed for gamma-emitting radionuclides, specific alpha-emitting radionuclides (U-234, U-235, U-238, and Am-241), VOCs, SVOCs, pesticides, and PCBs. This analytical suite encompasses all suspected contaminants based on the pit content sampling conducted in 1987 and 1989. No gamma-emitting radionuclides or U-235 were detected in the three samples. U-234 and U-238 were detected in all three samples at below background concentrations. Am-241 was detected in two of the three samples at 0.16 ± 0.04 pCi/g and 0.20 ± 0.06 pCi/g.

Results of the VOC analysis indicated the presence of acetone, ethylbenzene, and xylene (total), and one tentatively identified compound (TIC). However, according to the case summary provided by the analytical laboratory, the positive results for ethylbenzene and xylene are false positives because of instrument contamination in the laboratory from a previous sample analysis, and the two compounds are not actually present in the sample. Only acetone at an average concentration of 6 µg/kg was detected in the other two samples. The SVOC analysis identified 1,1,2,2-tetrachloroethane and 2,6-bis(1,1-dimethylphenol), both TICs, in the verification samples; however, several SVOC TIC data points were rejected during the data validation process. 1,1,2,2-Tetrachloroethane and 2,6-bis[1,1-dimethylphenol], both at estimated concentrations of 160 µg/kg in sample 1TA15501 and two unknown compounds in sample 1TA15601 at estimated concentrations of 420 and 180 µg/kg, were detected. No pesticides or PCBs were detected in any of the samples.

4.1.1.3 Nature and Extent of Contamination. Based on the sampling results, residual contamination at TSF-11 consists of low levels of acetone, TICs 1,1,2,2-tetrachloroethane and 2,6-bis[1,1-dimethylphenol], and Am-241. A summary of the analytical results for Am-241 is presented in Table 4-1. The TICs will be discussed qualitatively in the BRA uncertainty section (Section 6.6).

The extent of contamination at the site is assumed to begin at 2.1 m (7 ft) and terminate at 3 m (10 ft) bgs, and to encompass the site area of TSF-11 at approximately 3.7 m^2 (40 ft^2) based on Am-241 detections in two of three verification samples. The depth assumed is consistent with observations in Doornbos et al. (1990), which concluded that americium (along with other nuclides) was generally retained in the top 2.5 ft of soil, and is conservative because of the relative immobility of SVOCs as well as Am-241. Figure 4-2 shows the assumptions for the nature and extent of contamination and source-term estimates for TSF-11.

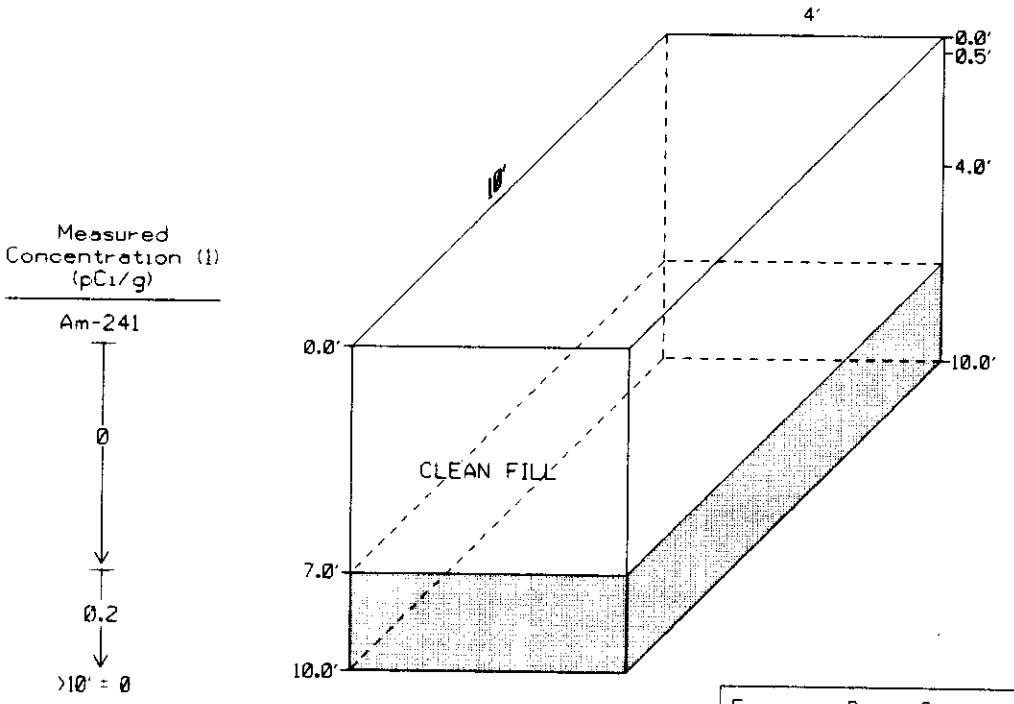
The COPC for the TSF-11 clarifier pits, based on the contaminant screening process detailed in Section 6 and Table B-18, is shown in Table 4-1.

4.1.2 OU 1-03: TSF-03 Burn Pit

4.1.2.1 Site Summary. The TSF-03 Burn Pit is located northwest of the Columbia Street gate access, outside the TSF perimeter fence as shown on Figure 4-3. TSF-03 was used for open burning of combustible waste from 1953 to 1958. A review of aerial photos indicates that the TSF-03 Burn Pit operated approximately from 1956 to 1958. The pit received refuse, construction debris, and combustible liquids (i.e., petroleum products) from the TAN areas (Meyer et al. 1992). It is possible that some oil, Stoddard solvent, and oily waste (from the limited maintenance activities at TAN) were burned at the pit. Records and volumes of the burned materials were not kept; however, no Resource Conservation and Recovery Act (RCRA) waste is suspected of having been disposed of at this site as the pit was not intended for use other than the type of material previously stated. The use of this pit was discontinued when similar disposal operations started at the WRRTF-01 Burn Pits in 1958. The site has been backfilled, subsidence-control maintained, and vegetation has been naturally reestablished. The exact location of the TSF-03 Burn Pit was unknown before the OU 1-03 Track 2 investigation.

Table 4-1. Summary statistics for TSF-11.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Am-241	0.16 +/– 0.04	0.2 +/– 0.06	1.25E–01	9.73E–02	3	2	66%	0.019	2



Exposure Point Concentration (2) (pCi/g)		
Receptor/Pathway	Depth	Am-241
Occ (3) - Air	Ø-Ø.5'	Ø
Occ (3) - External Rad.	Ø-4'	Ø
Res (4) - All	Ø-10'	Ø.Ø6
Res (4) - Groundwater	Ø>10'	Ø.Ø6

LEGEND

Zone of contamination for Am-241.

ASSUMPTIONS:

- The area of contamination is assumed to be the area of the site.
- Site was excavated to 2.13 m (7 ft) and backfilled with clean soil.
- Am-241 detected in verification samples above background, Ø.2Ø pCi/g is the maximum.
- Contamination conservatively assumed from 2.13 m (7 ft) to 3.Ø5 m (1Ø ft) bgs because of the relative immobility of Am-241 in the subsurface.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-2. OU 1-01: TSF-11, TSF clarifier pits, nature and extent assumptions.

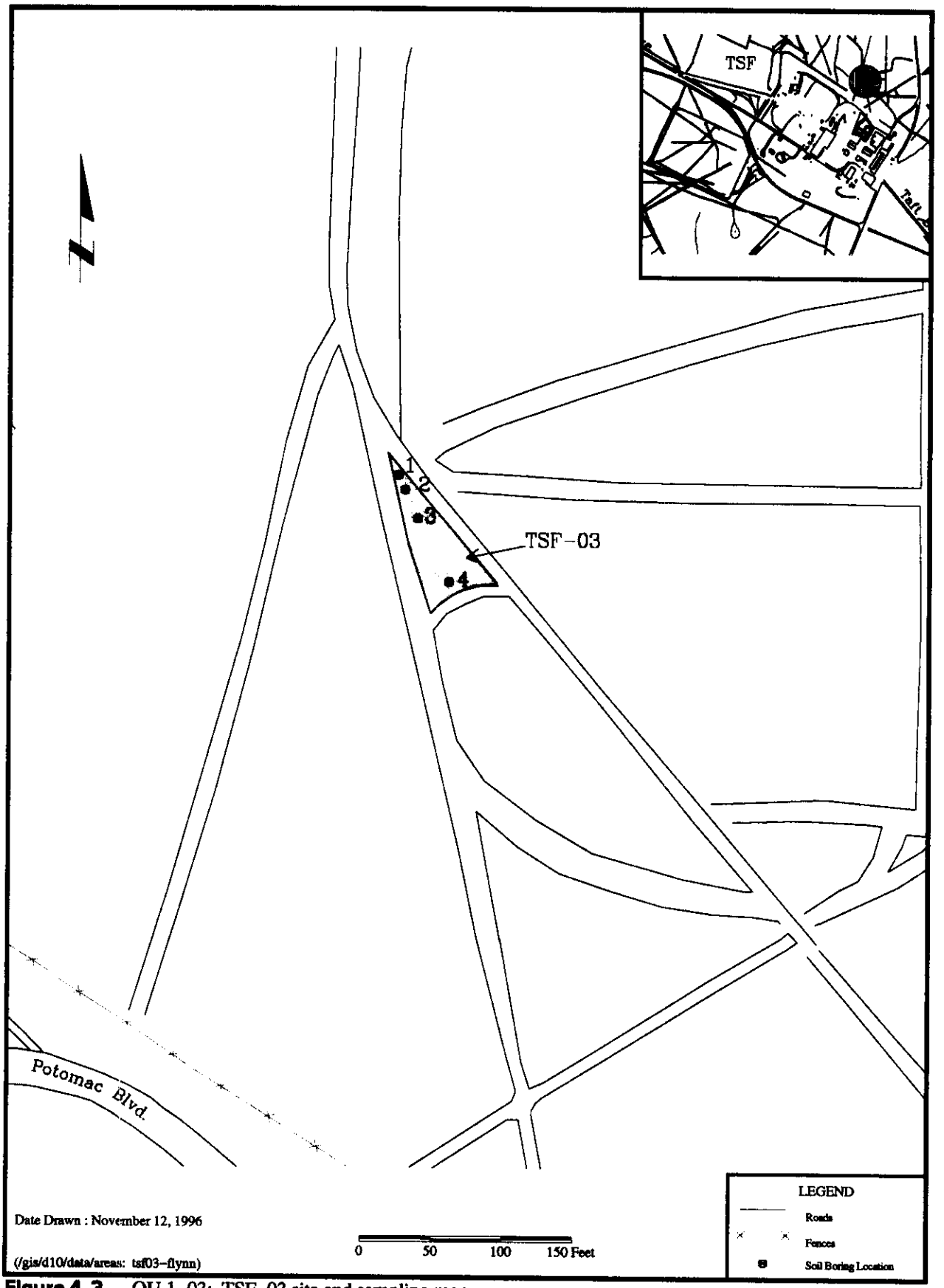


Figure 4-3. OU 1–03: TSF–03 site and sampling map.

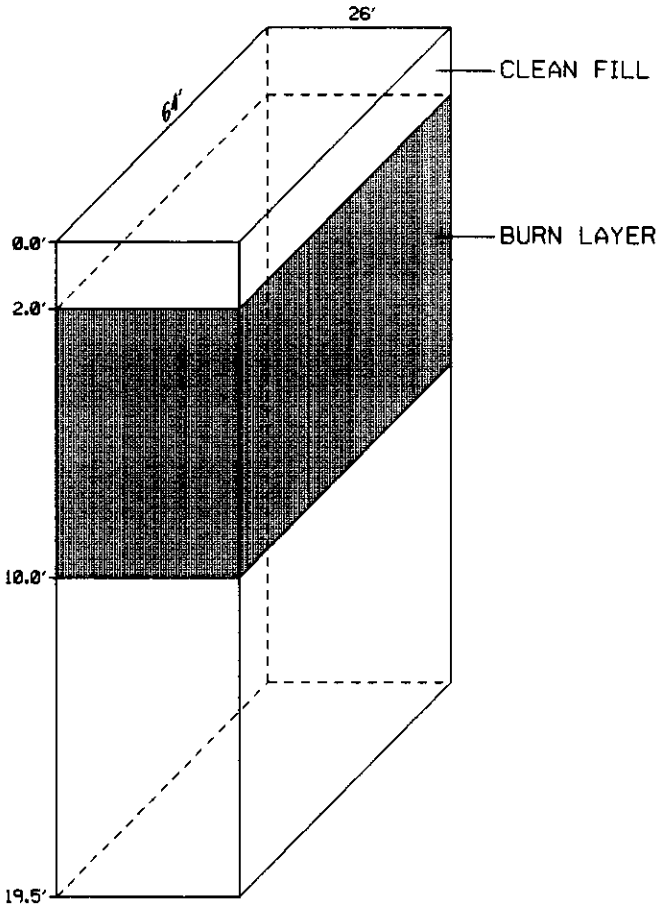
The normal operating procedure at the burn pit was to incinerate each time materials were disposed of in the pit. The main constituents of concern at the TSF-03 Burn Pit were chromium, lead, and mercury because these contaminants were used in large quantities at the TAN facilities during the operation of the burn pit and are most likely to be present at the site. VOCs were also present at the site; however, it is likely that most of the VOCs and SVOCs would have been volatilized or thermally destroyed because disposal practices consisted of burning and crushing. Operations at the TAN facilities involved the use of radionuclides; however, radionuclides are not suspected to have been disposed of in the burn pit. They are not suspected because TAN was under construction from 1953 to 1958, and research involving radioactive constituents was not under way at that time. Although an effort to sample this burn pit was undertaken in 1988, samples were mistakenly collected from an area about 300 m (984 ft) outside of the pit. Analytical information from this sampling effort is not included in this report because the actual location of the TSF-03 Burn Pit was not sampled.

4.1.2.2 Previous Investigations. Four borings were installed in the TSF-03 Burn Pit to determine general site conditions and the nature and extent of contamination (EG&G 1993). The samples were analyzed for TCL VOCs, select target analyte list metals, gamma spectroscopy, and gross alpha/beta. Based on the information obtained from the borings, the clean soil cover was determined to range from 0.61 to 1.8 m (2 to 6 ft) with an average thickness of 1.4 m (4.5 ft). The burn layer ranged from 1.2 to 2.4 m (4 to 8 ft) thick with an average thickness of 1.8 m (6 ft). The material encountered during the installation of the borings included glass, metallic objects, fiberglass, and charcoal. The depths of the burn pit (base of the burn layer) ranged from 2.7 to 3.7 m (9 to 12 ft) bgs. Native soil characteristics included poorly graded sand containing silt or clay or both. The upper surface of basalt was not determined at the burn pit.

Contaminants detected in samples collected from the burn layer in concentrations exceeding the Idaho National Environmental and Engineering Laboratory (INEEL) background included tetrachloroethene, VOCs detected as TICs, mercury, chromium, lead, U-234, and U-238. The presence of these contaminants is consistent with the disposal practices at the burn pit.

4.1.2.3 Nature and Extent of Contamination. Based on the sampling results of the Track 2 investigation of the TSF-03 Burn Pit (visual inspection, borings, geophysical survey) the surficial boundary dimensions are estimated to be 7.9 by 19.5 m (26 by 64 ft) [1,664 ft^2 (507 m^2)] (EG&G 1993). The burn-pit interval assumed to be contaminated with tetrachloroethene, VOCs detected as TICs, mercury, chromium, lead, U-234, and U-238 is from 0.61 m (2 ft), which is the minimum soil cover thickness, to 3 m (10 ft) using the maximum burn layer interval thickness of 2.4 m (8 ft). The interval assumed to be contaminated only mercury, chromium, and lead is from the shallowest burn layer occurrence at 2.7 m (9 ft) to the deepest sampling depth of 5.9 m (19.5 ft). These assumptions are considered conservative based on the sample analysis results (only lead was significantly above INEEL background concentrations in the deepest sample) and using the minimum clean soil cover and maximum burn layer interval thickness. An additional conservative assumption used in defining the nature and extent of contamination is that, although a particular contaminant may not have been detected in all samples for a given interval, that interval is considered to be contaminated with that particular contaminant. Also, since no SVOC data was available for TSF-03 but the available data suggested the presences of SVOCs, the SVOC data from WRRTF-01 Burn Pit III was included in the assessment of TSF-03 to extrapolate SVOC concentrations at TSF-03. The assumption for Figure 4-4 shows the nature and extent of contamination as well as the source-term estimates for TSF-03.

The COPCs for the TSF-03 Burn Pit, based on the contaminant screening process detailed in Section 6 and Table B-4, are shown in Table 4-2.



LEGEND

Zone of contamination.

ASSUMPTIONS:

- The area of contamination is defined by the boundaries of the burn pit.
- The zone of contamination is assumed from .61 m (2 ft) bgs (the minimum depth observed) to 3.05 m (10 ft) bgs (accounting for 2.44 m (8 ft) of maximum thickness observed).
- Residual contamination is conservatively assumed to 5.94 m (19.5 ft) bgs for lead.

NOTES:

- The COPCs for this site (lead, 2-methylnapthalene, phenanthrene) have no toxicity information available. Concentrations are provided on Table 4-2. The COPCs will be discussed in the uncertainty section.

Figure 4-4. OU 1-03: TSF-03 nature and extent assumptions.

Table 4-2. Summary statistics for TSF-03.

COPCs	Concentration (mg/kg or pCi/g)								
	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Lead	23.4 S*J F	2820 *J F	5.48E+02	8.52E+02	10	10	100%	23	10
2-Methylnaphthalene	7.9	10.3	6.13E+00	5.28E+00	3	2	66%	—	NA
Phenanthrene	5.8	8.7 J	4.90E+00	4.32E+00	3	2	66%	—	NA

S = The reported value was determined by the Method of Standard Additions.

* = Duplicate analysis not within control limits.

J = Estimated.

F = Furnace AA.

4.1.3 OU 1-03: WRRTF-01 Burn Pits

4.1.3.1 Site Summary. The WRRTF-01 Burn Pits are located approximately 823 m (2,700 ft) north of WRRTF-01, outside the WRRTF perimeter fence, and are shown on Figure 4-5. These burn pits were used for open burning of combustible waste generated at the TAN facilities from 1958 to 1975, and involved four separate areas (Saint-Louis 1986 and Meyer et al. 1992). Burn Pit I opened after the TSF-03 Burn Pit was filled, and received both combustible solids and liquids from 1958 to 1964. Burn Pits II and III were opened after Burn Pit I was filled and operated from 1964 to 1970. Burn Pit II also may have received only combustible solids while Burn Pit III received only combustible liquids (these liquids consisted mainly of oil from the glass windows at the TAN Hot Shop and the isopropyl alcohol used to clean this oil off the windows during replacement). Burn Pit III also received petroleum products. Burn Pit IV was opened after Burn Pit II was filled and received mainly combustible solids and some reportedly noncombustible solids (automobiles, metal goods, etc.) Minor amounts of combustible liquids may have been disposed in Burn Pit IV. The sites have been backfilled and vegetation has been reestablished; however, at Pits I, II, and IV subsidence control has not been maintained.

The normal operating procedure employed at the burn pits was to incinerate each time material was disposed of in the pits. Therefore, it is likely that most of the volatile and semivolatile hazardous materials would be thermally destroyed and dissipated. The main constituents of concern at the WRRTF-01 Burn Pits are chromium, lead, and mercury because these contaminants were used in large quantities at the TAN Facilities during the use of the burn pits and are the most likely to be present at the sites. Radionuclides are not suspected to have been disposed of in the WRRTF Burn Pits in large quantities because other protocols existed for disposal of radioactive waste. However, these pits operated from 1958 and 1975, and research involving radionuclides was being performed at TAN. As a result of this research, the potential for radionuclide contamination was addressed in the field sampling plan (FSP) for the burn pits.

Track 2 data collection was conducted at the WRRTF-01 Burn Pits during June 1992. Four borings were drilled at WRRTF Burn Pits I, II, and III. Eight borings were drilled at WRRTF-01 Burn Pit IV, because of its longer length. The total number of borings drilled was 20. For each boring, the entire depth of the burn layer was continuously sampled in increments of 0.6 m (2 ft), using a split-barrel sampler. Each split-barrel sample was field screened for VOCs and radiation. A composite sample of the burn layer was collected for chromium, lead, and mercury analyses. The remaining portion of the split-barrel was retained for gross alpha and beta, gamma spectroscopy, VOC, and headspace analyses. SVOC analysis was also performed on samples collected from the WRRTF-01-III burn pit. In addition, as part of the Track 2 investigation, a geophysical survey was performed to better define the burn-pit boundaries.

4.1.3.2 WRRTF-01 Burn Pit I.

4.1.3.2.1 Previous Investigations—Four borings were drilled in WRRTF-01 Burn Pit I (see Figure 4-5) to determine general site conditions and the nature and extent of contamination (EG&G 1993). The average soil cover thickness was determined to be 0.9 m (3 ft) while ranging from 0.6 to 0.9 m (2 to 3 ft). The burn-layer thickness encountered in the borings ranged from 0.9 to 1.5 m (3 to 5 ft) with an average thickness of 1.2 m (4 ft). Material encountered during the installation of the borings included glass, metallic objects, grease, porcelain, paper, and charcoal. The depths of the burn pit (base of the burn layer) ranged from 1.5 to 2.7 m (5 to 9 ft) bgs. Native soil characteristics included poorly sorted sand with gravel, some silt, and minor amounts of clay. Although the upper surface of basalt was not determined in the WRRTF-01 I Burn Pit, basalt is assumed to begin at 3 to 6.7 m (10 to 22 ft) bgs based on information obtained from the WRRTF-01 III and IV borings.

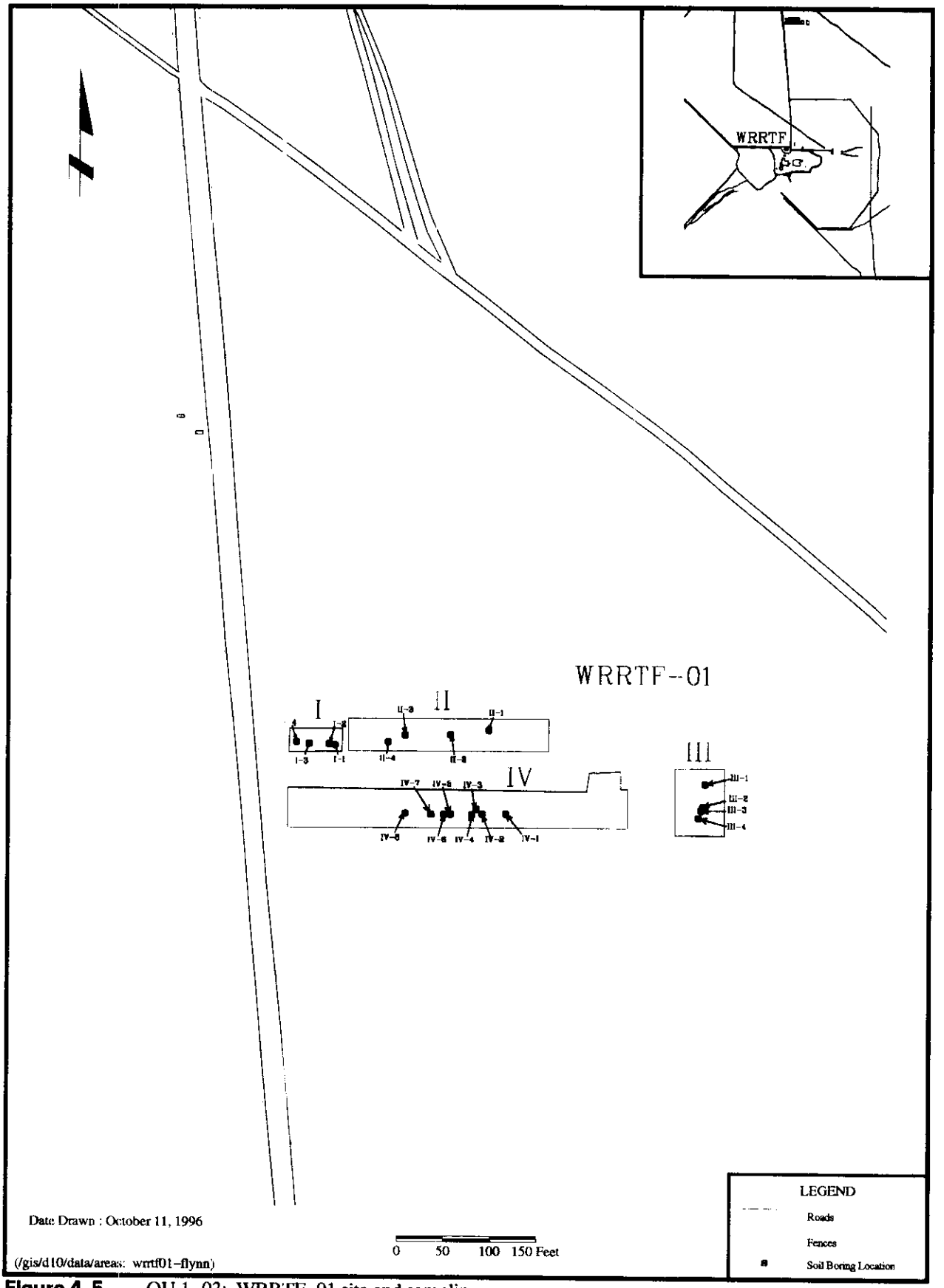


Figure 4-5. OU 1–03: WRRTF–01 site and sampling map.

Contaminants detected in samples collected from the burn layer in concentrations exceeding the INEEL background included toluene, ethylbenzene, xylene, acetone, mercury, chromium, lead, Pu-239/-240, U-234, and U-238. Beneath the burn layer, contaminant concentrations exceeding INEEL background included xylene, chromium, and lead. In addition, TICs were detected in both the burn layer (997 to 24.4 µg/kg) and in the soil below the burn layer (119 to 86 µg/kg). The presence of these is a consistent with TAN operations and the disposal practices at the burn pit.

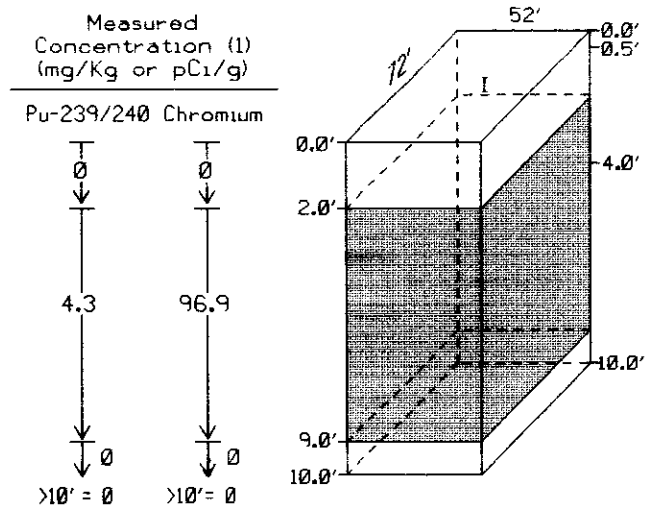
4.1.3.2.2 Nature and Extent of Contamination—Based on the sampling results of the Track 2 Investigation of the WRRTF-01 Burn Pit I (visual inspection, borings, and the geophysical survey), the surficial boundary dimensions are estimated to be 16 by 22 m (52 by 72 ft) [3,744 ft^2 (1,141 m^2)] (EG&G 1993). The interval contaminated with organics in the burn pit is assumed to be from 0.61 m (2 ft), which is the minimum soil-cover-thickness depth, to a maximum depth of 67 m (22 ft). The assumption is based on the presence of TICs in samples collected at 4.9 m (16 ft) and the likely maximum soil horizon thickness. For metals and radionuclides, the contaminated interval is assumed to be from 0.61 m (2 ft), which is the minimum soil cover-thickness depth to 2.1 m (7 ft), which is the maximum burn-layer thickness, because below the burn layer they were not detected in samples at concentrations higher than INEEL background values. These assumptions are considered conservative based on the sample analysis results (ppb TIC concentrations detected in the deepest sample), using WRRTF-01 IV boring data to establish a likely maximum soil horizon thickness, and using the minimum soil cover and maximum burn layer thickness for the entire burn pit. An additional conservative assumption used in defining the nature and extent of contamination is that, although a particular contaminant may not have been detected in all samples, the entire burn pit is considered to be contaminated. Figure 4-6 shows the assumptions for the nature and extent of contamination and source-term estimates for WRRTF-01.

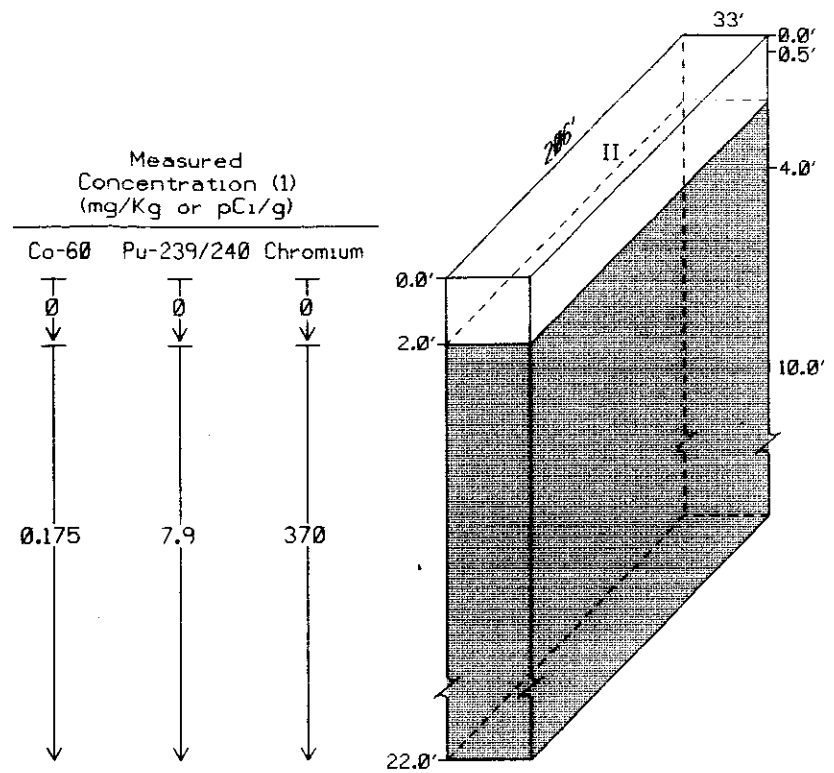
The COPCs for the WRRTF-01 Burn Pit I, based on the contaminant screening process detailed in Section 6 and Table B-27, are shown in Table 4-3.

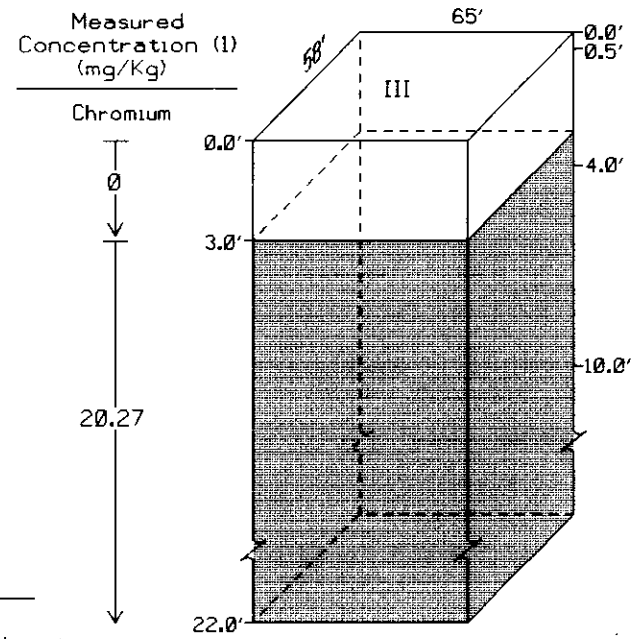
4.1.3.3 WRRTF-01 Burn Pit II.

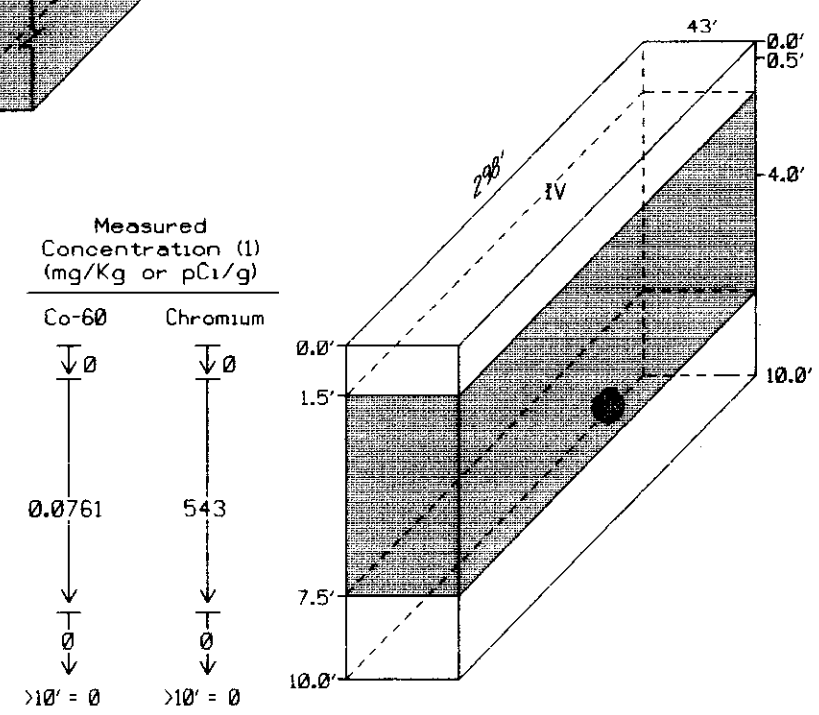
4.1.3.3.1 Previous Investigations—Four borings were installed in the WRRTF-01 Burn Pit II (see Figure 4-5) to determine the general site conditions and the nature and extent of contamination (EG&G 1993). Based on the information obtained from the borings, the clean soil cover was determined to range from 0.61 to 1.5 m (2 to 5 ft) with an average thickness of 1.1 m (3.5 ft). The burn layer ranged from 0.3 to 1.5 m (1 to 5 ft) thick with an average thickness of 1.2 m (4 ft). The material encountered during the installation of the borings included glass, metallic objects, wood, ironed stained sand, charcoal, and possibly asbestos. The depths of the burn pit (as defined by the base of the burn layer) ranged from 1.7 to 2.7 m (5.5 to 9 ft) bgs. Native soil characteristics included poorly sorted sand and gravel with some silt. Although the upper surface of basalt was not determined in the WRRTF-01 Burn Pit II, it is assumed to begin at 3 to 6.7 m (10 to 22 ft) bgs based on information obtained from the WRRTF-01 III and IV borings.

Contaminants detected in samples collected from the burn layer in concentrations exceeding the INEEL background included 2-Propenylcyclohexane (TIC), mercury, chromium, lead, Pu-239/240, U-234, U-238, and Co-60. Beneath the burn layer contaminants with concentrations exceeding INEEL background included mercury, chromium, and lead. The presence of these contaminants is consistent with the disposal practices at the burn pit.









LEGEND

Zone of contamination for each pit.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest. These concentrations were area-weighted by pit prior to volume-weighting.

(3) Occupational Scenario

(4) Residential Scenario

(5) The following COPCs were identified but do not have toxicity values: 2-hexanone, 2-methylnaphthalene phenanthrene, lead, 2-propylcyclohexane. Concentrations are presented on Table 4-3. The COPCs will be discussed in the uncertainty section.

Exposure Point Concentration (2) (mg/Kg or pCi/g)				
Receptor/Pathway	Depth	Co-60	Pu-239/240	Chromium
Occ (3) - Air	Ø-0.5'	0.00	0.00	0.00
Occ (3) - External Rad.	Ø-4'	0.05	1.29	246.18
Res (4) - All	Ø-10'	0.06	1.94	263.77
Res (4) - Groundwater	Ø>10'	0.04	1.96	93.28

Figure 4-6. OU 1-03: WRRTF-01 nature and extent assumptions.

Table 4-3. Summary statistics for WRRTF-01.

COPCs	Concentration (mg/kg or pCi/g) Minimum Detected	Maximum Detected	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Chromium	8.9 *J P	543 * J P	40	40	100%	50	100%
Lead	3 F	2350 * J F	40	40	100%	23	19
2-Hexanone	0.019	0.019	37	1	3%	—	NA
2-Methylnaphthalene	7.9	10.3	3	2	66%	—	NA
Phenanthrene	5.8	8.7 J	3	2	66%	—	NA
Co-60	0.0761	0.175	2	2	100%	—	NA
Pu-239/240	4.3	7.9	5	2	40%	0.19	4

* = Duplicate analysis not within control limits.

J = Estimated

P = ICP

F = Furnace AA

4.1.3.3.2 Nature and Extent of Contamination—Based on the sampling results of the Track 2 investigation of the WRRTF-01 Burn Pit II (visual inspection, borings, and a geophysical survey), the surficial boundary dimensions are estimated to be 10 by 62.8 m (33 by 206 ft) [6,798 ft^2 (632 m^2)] (EG&G 1993). The interval assumed to be contaminated with organics (2-Propenylcyclohexane) is from 0.61 m (2 ft), which is the minimum soil-cover-thickness depth, to 1.5 m (5 ft), which is the maximum burn-interval-thickness depth. This assumption is supported by the lack of organics detected in soil samples collected below the burn layer in all four borings. The interval contaminated with inorganics is assumed to be from 0.61 to 6.7 m (2 to 22 ft), which is the maximum sampling depth, to 6.7 m (22 ft), which is the likely maximum soil-horizon-thickness), because mercury and chromium were detected in a sample collected 5 ft (1.5 m) below the burn layer. Radionuclide contamination is assumed to be present in the same interval assumed to be contaminated with inorganics, based on the detection of the metals at the 4.9-m (16-ft) depth, although samples were collected for radionuclide analysis only from the burn layer. These assumptions are considered to be conservative based on the sample analysis results (no organics were detected below the burn layer), using (1) the minimum soil cover and maximum burn layer thickness, using (2) WRRTF-01 III and IV boring data to establish a likely maximum soil horizon thickness, and (3) the inorganic contaminated interval for the radionuclides. An additional conservative assumption used in defining the nature and extent of contamination is that, although a particular contaminant may not have been detected in all borings, the entire burn pit is considered to be contaminated (see Figure 4-6).

The COPCs for the WRRTF-01 Burn Pit II, based on the contaminant screening process detailed in Section 6 and Table B-27, are shown in Table 4-3.

4.1.3.4 WRRTF-01 Burn Pit III.

4.1.3.4.1 Previous Investigations—Four borings were installed in the WRRTF-01 Burn Pit III (see Figure 4-5) to determine the general site conditions and the nature and extent of contamination (EG&G 1993). Based on the information obtained from the borings, the clean soil cover was determined to range from 0.91 to 1.2 m (3 to 4 ft) with an average thickness of 0.91 m (3 ft). The burn layer ranged from 1.2 to 4.7 m (4 to 15.5 ft) thick with an average thickness of 2.7 m (9 ft). The material encountered during the installation of the borings included glass, metallic objects, wood, darkly stained soil, and charcoal. The depths of the burn pit (base of the burn layer) ranged from 2.4 to 5.8 m (8 to 19 ft) bgs. Native soil characteristics included poorly sorted sand with traces of silt and gravel. The upper surface of basalt was encountered at approximately 6.7 m (22 ft) bgs in boring WRRTF-01-III-3.

Contaminants detected in samples collected from the burn layer in concentrations exceeding INEEL background values included trichloroethene, tetrachloroethene, xylene, ethylbenzene, toluene, acetone, 2-hexanone, 4-methyl-2-pentanone, naphthalene, 2-methylnapthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, fluoranthene, 1,1,1-trichloroethane, U-234, U-238, chromium, lead, and VOCs detected as TICs. The presence of these is consistent with TAN operations and the disposal practices at the burn pit.

4.1.3.4.2 Nature and Extent of Contamination—Based on the sampling results of the Track 2 investigation of the WRRTF-01 Burn Pit III (visual inspection, borings, and a geophysical survey), the surficial boundary dimensions are estimated to be 17.7 by 19.8 m (58 by 65 ft) [3,770 ft ($1,149 m^2$)]. The burn pit interval assumed to be contaminated with ethylbenzene, toluene, trichloroethene, acetone, fluorene, phenanthrene, fluoranthene, 1,1,1-trichloroethane, U-234, and U-238, is from 0.91 to 3.7 m (3 to 12 ft), which is the minimum clean-soil-cover depth, of using the average burn-layer thickness of 2.7 m (9 ft). The interval from 0.91 m (3 ft), which is the depth of the layer of the minimum soil-cover thickness, to 6.7 m (22 ft), which is the upper surface of basalt, assumed to be contaminated with xylene,

2-hexanone, 4-methyl-2-pentanone, naphthalene, 2-methylnapthalene, acenaphthene, dibenzofuran, anthracene, fluoranthene, VOCs detected as TICs, and lead. These assumptions are considered conservative based on the sample analysis results, using (1) an average burn-layer thickness rather than the maximum thickness because the boring data indicate that the 4.7-m (15.5-ft) thick burn layer in Boring 3 is anomalous, and (2) the minimum soil-cover thickness, and because Boring 4 had only minimal contamination. An additional conservative assumption used in defining the nature and extent of contamination is that, although a particular contaminant may not have been detected in all samples for a given interval, the interval is considered to be contaminated (see Figure 4-6).

The COPCs for the WRRTF-01 Burn Pit III, based on the contaminant screening process detailed in Section 6 and Table B-27, are shown in Table 4-3.

4.1.3.5 WRRTF-01 Burn Pit IV.

4.1.3.5.1 Previous Investigation—Eight borings were installed in the WRRTF-01 Burn Pit IV (see Figure 4-5) to determine the general site conditions and the nature and extent of contamination (EG&G 1993). Based on the information obtained from the borings, the clean-soil cover was determined to range from 0.1 to 2.7 m (0.5 to 9 ft) with an average thickness of 0.46 m (1.5 ft). The burn layer ranged from 0.46 to 3.8 m (1.5 to 12.5 ft) thick with an average thickness of 1.8 m (6 ft). The material encountered in the burn layer included glass, metallic objects and shavings, wood, fiberglass, and charcoal. The depths of the burn pit (the base of the burn layer) ranged from 2.0 to 4.0 m (6.5 to 13 ft) bgs. Native soil characteristics included poorly sorted gravely sand with gravel or silt or both and some clay. The upper surface of basalt ranged from approximately 2.9 to 4.9 m (9.5 to 16 ft) bgs.

Contaminants detected in samples collected from the burn layer in concentrations exceeding INEEL background values included chromium, lead, Co-60, xylene, and VOCs detected as TICs. The presence of these contaminants is consistent with TAN operations and the disposal practices at the burn pit.

4.1.3.5.2 Nature and Extent of Contamination—Based on the sampling results of the Track 2 investigation of the WRRTF-01 Burn Pit IIV (visual inspection, borings, and a geophysical survey), the surficial boundary dimensions are estimated to be 13.1 by 90.8 m (43 by 298 ft), [12,814 ft^2 (1,190 m^2)] (EG&G 1993). The burn-pit interval assumed to be contaminated with chromium, lead, Co-60, xylene, and VOCs detected as TICs is from 0.46 to 2.3 m (1.5 to 7.5 ft), which includes the average clean-soil thickness and the average burn-layer thickness. No contaminants above INEEL background concentrations were detected in the samples collected above the burn layer. Using the average thickness for the clean-soil layer and burn layer to determine the contaminated interval thickness is considered conservative based on the wide ranges encountered in the borings for the thickness of the layer clean-soil and the layer burn. An additional conservative assumption used in defining the nature and extent of contamination is that, although a particular contaminant may not have been detected in all borings for a particular interval, the interval is considered to be contaminated with the contaminant (Figure 4-6).

The COPCs for the WRRTF-01 Burn Pit IV, based on the contaminant screening process detailed in Section 6 and Table B-27, are shown in Table 4-3.

4.1.4 OU 1-04: TSF-29, Acid Pond (TAN-735)

4.1.4.1 Site Summary. TSF-29, the TSF acid pond, is an unlined drainage pond located northwest of the railroad turntable at TSF and within the boundaries of the OU 1-05 TSF-06 radioactive soil area. TSF-29 is shown on Figure 4-7. The pond was constructed to receive surface water runoff from the

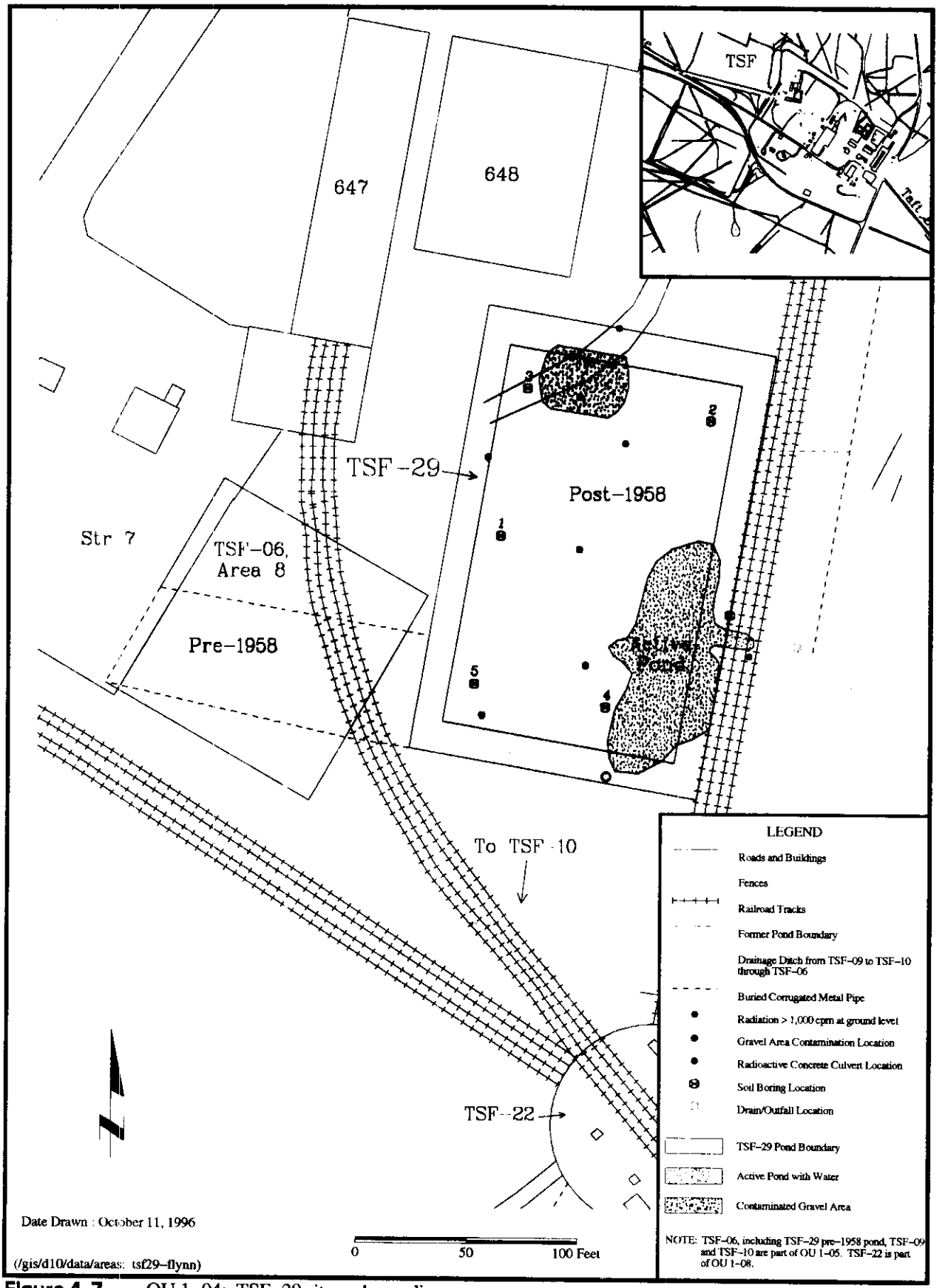


Figure 4-7. OU 1–04: TSF–29 site and sampling map.

4.1.4.2 Previous Investigations. Historical information indicates that contaminants were disposed in the TSF-29 acid pond either as liquid discharge or as backfilled soil. The OU 1-04 Track 2 investigation focused on the surface soil, pond backfill, and sediment, and the soil in the active portion of the pond and the associated drainage ditch. The phased Track 2 investigation included Phase I radiation and geophysical surveys in advance of Phase II pond and surface and subsurface soil sampling.

The Phase I walkthrough radiation survey for the acid pond area was conducted across the entire bottom of the pond on a 3-m (10-ft) grid pattern. Measurements were collected at 122 locations throughout the acid pond. Because the active portion of the acid pond contained water, it was not surveyed. Background radiation in the pond averaged 210 cpm. Radiation measurements in the pond ranged from a minimum of 120 cpm to a maximum of 20,000 cpm in the gravel area. The average radiation measurement for the TSF-29 pond, excluding particles (considered for this survey as greater than 1,000 cpm), was 220 cpm, which indicates that the main radiation source at the site is from particles. Seven particles were detected in the TSF-29 acid pond (excluding the gravel area) with radioactivities ranging from 1,000 to 10,000 cpm. The average of the radiation measurements of the particles was 6,400 cpm. Phase I field activities included a study of soil behavior and surface water movement at TSF-29. Observations of soil behavior and surface water movement indicate that evaporation, and not infiltration, is the principal water-loss process at the site.

Following review of the data collected during Phase I, a revised Phase II sampling program was initiated. Field screening and soil sampling activities were performed at five shallow subsurface borings within TSF-29, a boring located within the active pond, and a pond liquid sample from the active pond. The five soil composite samples and one duplicate sample were collected from 1 to 1.5 m (3 to 5 ft) and analyzed for gross alpha/beta activity. The gross alpha activity ranged from a minimum of 7.6 pCi/g to a maximum of 30 pCi/g with an average activity of 19.1 pCi/g. The gross beta activity ranged from 26 to 32 pCi/g, with an average beta activity of 29.5 pCi/g. Gamma spectroscopy, in the form of a 20-minute gamma screening, was also performed. The results indicated that Cs-137 was elevated above background in one of the pond sediments boring.

4.1.4.3 Nature and Extent of Contamination. Based on the sampling results, the COPCs for TSF-29 consist of the following radionuclides: Am-241, Cs-137, Cm-242, Cm-243/244, Np-237, and U-235. Only Am-241 and Cs-137 have an established background value to be used for comparison during the contaminant-screening process. The remaining radionuclides do not have background values and, therefore, are assumed to be COPCs regardless of their relatively low activities. The Track 2 risk evaluation determined that risk is driven by exposure to external radiation caused by Cs-137. The average radiation measurement for the TSF-29 acid pond is 220 cpm, when excluding the particles, which indicates that the primary radiation source at the site is from particles. The contaminated gravel area also contains areas of elevated activities.

The seven particles detected in the acid pond with elevated radioactivity are assumed to be Cs-137. Each is conservatively assumed to affect a 0.3-by-0.3-m (1-by-1-ft) area (the sensitivity of the detector) and to possibly affect a vertical distribution of 0.8 m (2.5 ft), resulting in a volume of 0.07 m^3 (2.5 ft^3) per particle, or a total of 0.5 m^3 (17.5 ft^3). In addition, the contaminated gravel area is assumed to have a vertical distribution of contamination to a depth of 0.8 m (2.5 ft). Limited mobility of the COPCs is assumed to restrict the vertical distribution of contamination. The dimensions of the contaminated gravel area are estimated to be 11.6 by 7.6 m (38 by 25 ft), resulting in an approximate area of 88.2 m^2 (950 ft^2). The estimated volume of the contaminated gravel area is, therefore, 67.3 m^3 (2,375 ft^3). The total volume of contamination for the particles and the contaminated gravel area is 67.8 m^3 (2,392.5 ft^3). The two borings placed during Phase II did not target the particle locations or gravel area. One of the two borings

had a concentration of Cs-137 at 16.1 pCi/g. Using this maximum to represent the majority of the pond sediment (i.e., 170 by 150 ft), a conservative source term estimate was calculated. The assumptions for the nature and extent of contamination as well as the source-term estimates are shown on Figure 4-8.

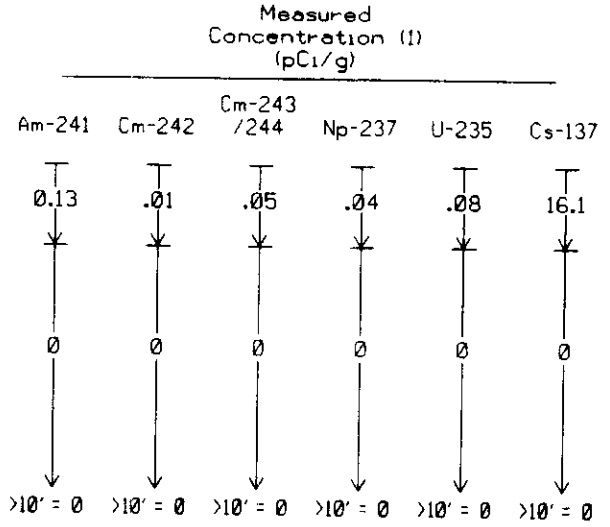
The COPCs for the TSF-29 acid pond, based on the contaminant screening process detailed in Section 6 and Table B-23, are shown in Table 4-4.

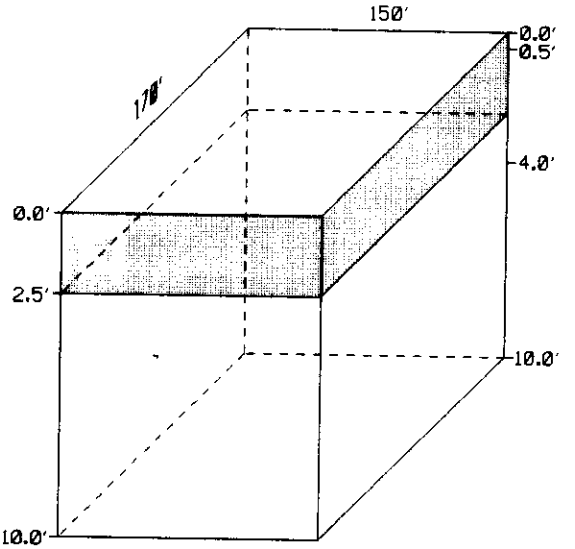
4.1.5 OU 1-05: TSF-06, TAN/TSF Soil Area

4.1.5.1 Site Summary. The TSF TAN/TSF-1 Area (soil area) (TSF-06) is a large potentially contaminated area, approximately 365.8 by 365.8 m (1,200 by 1,200 ft), which includes surface ponds, drainage ditches, railroad tracks, and large areas used for open storage of equipment. The soil area is located west and north of Building TAN-607 as shown in Figure 4-9. The primary contaminants associated with operations contaminating the TSF-06 site are gamma- and beta-emitting radionuclides (Cs-137, Co-60, Eu-154, and Sr-90), and mercury. Although solvents and other organic substances were used in decontamination and hot shop operations in TAN-607, most of the waste from these operations was not disposed of in the TSF area. Exceptions to this are in an area where liquids were reportedly spilled on the ground or where spills and surface runoff went through the TSF-06 ditch. During field screening for VOCs during the Track 2 investigation in these areas, no VOCs were detected (LMITCO 1994).

For evaluation in this RI/BRA the TSF-06 has been divided into 10 separate units. The segregation is based primarily on geographical differences as well as differences in contamination depth, which are in turn based on differences in the source of contamination at the units. The 10 units are as follows:

- Area 1, Soil Area northeast of turntable
- Area 3, TAN-781 Pond
- Area 5, Radioactive Soil Berm
- Area 7, Sil Box Storage
- Area 8, Cask Storage Pad/TSF-29 Pre-1958 Pond
- Area 9, Northeast Corner Soil Contamination
- Area 10, Reactor Vessel Burial Site
- Area 11, TSF-06 Ditch
- Area 12, Resin Bead Burial Site
- Area B, Soil Area South of Turntable.





Exposure Point Concentration (2) (pCi/g)							
Receptor/Pathway	Depth	Am-241	Cm-242	Cm-243/244	Np-237	U-235	Cs-137
Occ (3) - Air	0-0.5'	0.13	0.02	0.05	0.04	0.08	16.1
Occ (3) - External Rad.	0-4'	0.0975	0.015	0.0375	0.03	0.06	12.08
Res (4) - All	0-10'	0.039	0.006	0.015	0.012	0.024	4.83
Res (4) - Groundwater	0>10'	0.039	0.006	0.015	0.012	0.024	4.83

LEGEND

Zone of contamination for Am-241, Cm-242, Cm-243/244, Np-237, U-235, and Cs-137.

ASSUMPTIONS:

- The area of contamination is assumed to be the area of the site because of elevated radiation field measurements.
- The zone of contamination is assumed to be from the surface to .76 m (2.5 ft) bgs based on the relative immobility of Cs-137 (the primary COPC) in the environment. The assumption is substantiated by analytical results in 5 borings for which Cs-137 was not detected.
- Cs-137 concentrations were taken from results of a 20-minute gamma count and are assumed to represent conditions across the site. Concentrations of the other COPCs were determined by laboratory analysis.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-8. OU 1-04: TSF-29 nature and extent assumptions.

Table 4-4. Summary statistics for TSF-29.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Am-241	0.13 +/– 0.03	0.13 +/– 0.03	1.30E–01	NA	1	1	100%	0.019	1
Cm-242	0.02 +/– 0.02	0.02 +/– 0.02	2.00E–02	NA	1	1	100%	—	NA
Cm-243/244	0.05 +/– 0.02	0.05 +/– 0.02	5.00E–02	NA	1	1	100%	—	NA
Cs-137	0.909 +/– 0.09	16.1	8.50E+00	1.07E+01	2	2	100%	1.28	1
Np-237	0.04 +/– 0.02	0.04 +/– 0.02	4.00E–02	NA	1	1	100%	—	NA
U-235	0.08 +/– 0.05	0.08 +/– 0.05	8.00E–02	NA	1	1	100%	—	NA

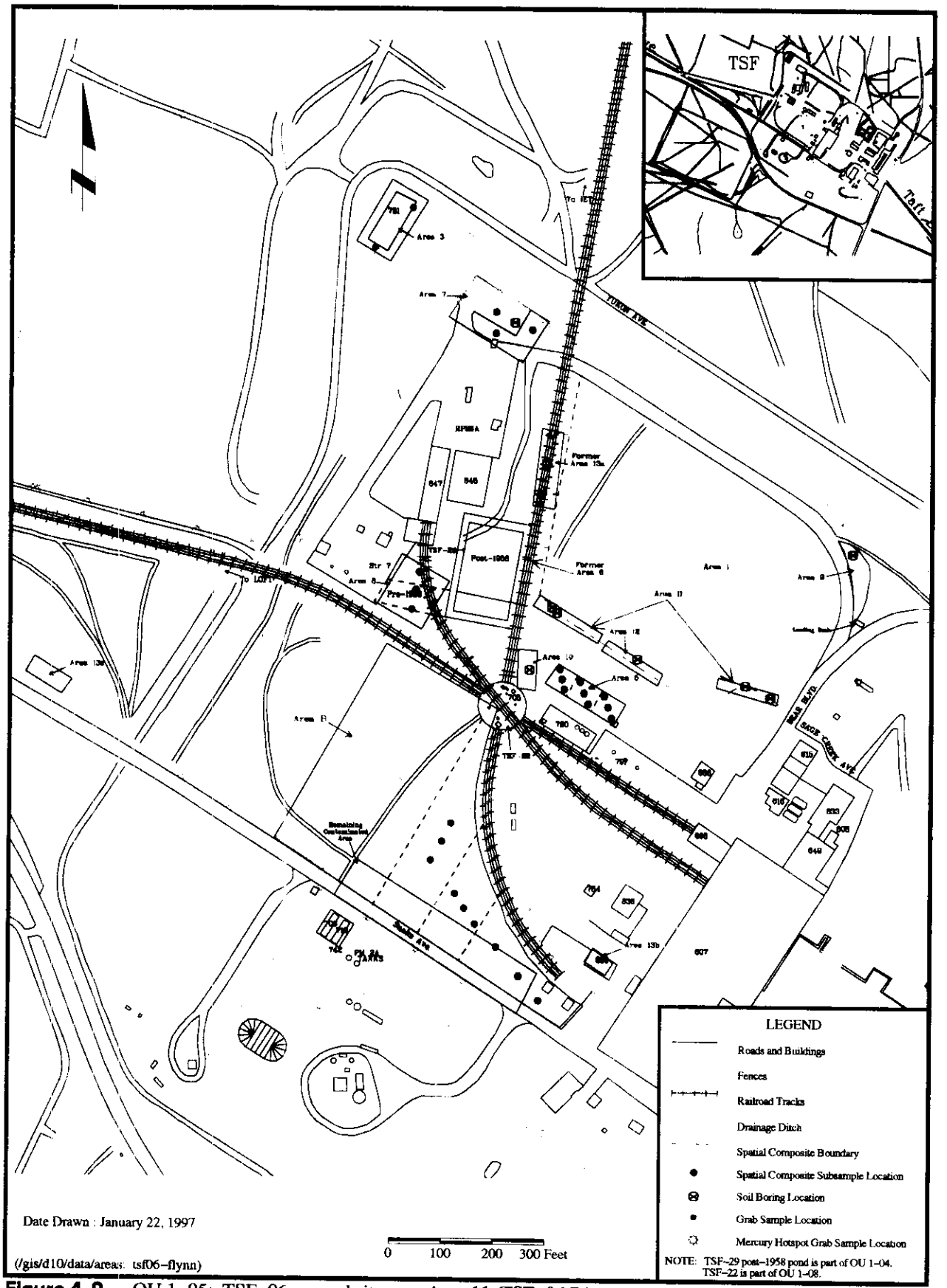


Figure 4-9. OU 1–05: TSF–06 general site map Area 11, TSF–06 Ditch.

The railroad turntable, located in roughly the center of the TSF-06 site, is considered a separate site (TSF-22) and is discussed in detail in Section 4.13. The Radioactive Parts Security Storage Area (RPSSA), located in the northwest portion of the TSF-06 site, consists of the two buildings, TAN-647 and TAN-648, and concrete pads surrounding the buildings. It is included in OU 1-01 as site TSF-43. This site was not retained for further evaluation in the risk assessment because the site is currently a RCRA interim storage unit (Lewis et al. 1996). However, it is discussed further in the WAG 1 co-located facility analysis (see Section 6.6.5 and Appendix D). TSF-29, the TSF acid pond, also located within the TSF-06 site, consists of two portions, the pre-1958 pond and the post-1958 pond. The majority of the pre-1958 pond is now overlain by Area 8, the cask storage site. Therefore, the pre-1958 pond has been included as part of Area 8 in this RI/BRA. The post-1958 pond is included in site TSF-29 in OU 1-04 and is discussed in detail in Section 4.4 of this report.

Approximately 2,438.4 m (8,000 ft) of railroad tracks transect TAN. During the 1993 Track 2 investigation at TSF-06, field screening along all of the railroad tracks at the TSF and between the TSF and the LOFT and the IET facility was performed using a portable Jerome mercury analyzer. Grab soil samples from 0.6 to 0.8 m (2 to 2.5 ft) bgs] were collected from three locations (13a, 13b, and 13c) where mercury vapors were detected. The results of the sampling in 13a are included in Section 4.1.5.6 of this report. The mercury concentration in the grab sample from Area 13b was 80.5 mg/kg. One grab sample was collected from Area 13c, located beneath the asphalt on Snake Road where the railroad tracks cross the road. The results of the sample analysis indicated that no mercury contamination was present in the soil collected in Area 13c. Gross alpha and gross beta activities appeared consistent with naturally occurring levels and no gamma-emitting radionuclides were detected in the sample (LMITCO 1994).

On the basis of the Track 2 sampling and analysis results, a time-critical removal action was initiated in 1994. Prior to beginning the removal action, 31 grab samples from the surface [0 to 0.1 m (0 to 0.5 ft) bgs] and from 0.6 to 0.8 m (2 to 2.5 ft) bgs were collected along Section H (where Area 13c was located) of the railroad tracks for mercury analysis. The one positive mercury detection of 0.06 mg/kg was below the contract-required quantification limit (CRQL). At three of the location samples were also collected for gross alpha and gross beta and gamma spectroscopy analyses. The gross alpha and beta results were consistent with background activities and no gamma-emitting radionuclides were detected (LMITCO 1995). On the basis of these results the removal action was limited to Area 13b. For evaluation in this RI/BRA, Area 13b is considered a separate site, TSF-08, and is discussed in detail in Section 4.1.11 of this report. All other sections of the railroad (except Area 13a, which is included in Area 1) have been eliminated from consideration in this RI/BRA, based on the results of the 1993 mercury vapor screening and the 1995 removal action results for Area 13c.

Information on the physical features, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) characterization and remediation activities, and the nature and extent of contamination in the 10 units included in the TSF-06 site are given in the following sections.

4.1.5.2 Area 1, Soil Area Northeast of Turntable.

4.1.5.2.1 Site Summary—The largest portion of TSF-06 is contained between the railroad tracks on the west, the TSF-06 ditch on the south, and roadways on the north and east. This area, shown in Figure 4-10, encompasses Area 1 and Area 13a, and a portion of Area 6 as defined in the Track 2 investigation (LMITCO 1994). Area 1, a large open soil area, used since the 1950s for the storage and disposal of radioactive equipment. The equipment, left uncovered, resulted in soil contamination because of exposure to precipitation and wind that transported radioactive particles off the equipment and into the soil. The primary contaminants associated with the site resulting from storage operations are radionuclides

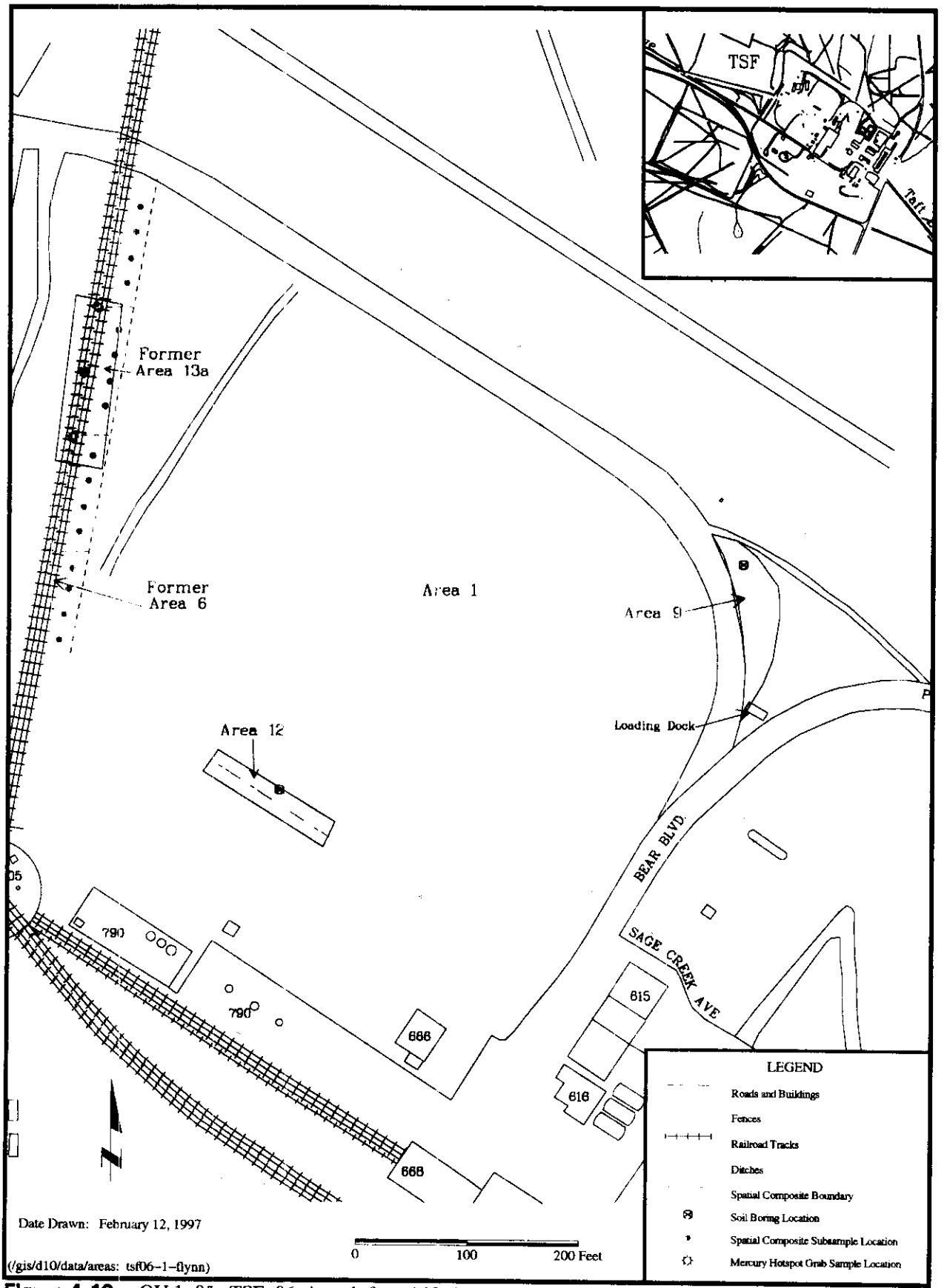


Figure 4-10. OU 1–05: TSF–06, Area 1, 9, and 12 site sampling map.

(e.g., Cs-137, Co-60, and Sr-90), although metals typically associated with radioactive processes at TAN may also be present (primarily mercury). There are anecdotal reports that the area was also used for the burial of waste and debris and the disposal of hazardous liquid waste, although there is no documentation on the types and quantities of the waste in the area. Also included in Area 1 is a portion of the rail system designated 13a. The railroad was built to support the Aircraft Nuclear Propulsion (ANP) program. Under this program Heat Transfer Reactor Experiment (HTRE) test assemblies were transported through the TSF area on the railroad track system and stored on the track near TAN-647 from the mid-1960s to 1987. Mercury, used as shielding for the reactors in the test assemblies, reportedly leaked onto the ground and the railroad equipment during transport and on two occasions was spilled during operations.

4.1.5.2.2 Previous Investigations—A large portion of Area 1 was characterized in 1983 for D&D evaluation. The D&D characterization indicated widespread surface contamination with radioactive particles reading up to 200 mR/h of beta/gamma radiation. Cs-137 and Co-60 activities in four surface soil samples collected in the area ranged from 32.2 ± 0.2 to 56.5 ± 0.5 pCi/g and 0.23 ± 0.02 to 4.09 ± 0.09 pCi/g respectively. Sr-90 was detected at 0.6 ± 0.1 to 5.4 ± 0.3 pCi/g (Clark and McQuary 1984). In 1990 an in situ gamma spectroscopy study was performed. The study, which collected surface soil gamma spectroscopy readings at 10-m (3-ft) intervals, encompassed all of the open soil area. The data indicated elevated Cs-137 concentrations of Section A of the railroad, along the west border of Area 1. The average Cs-137 and Co-60 activities in the whole area were 15 pCi/g and 0.32 pCi/g, respectively (LMITCO 1994). During the Track 2 investigation, a mobile beta/gamma radiation survey indicated surface soil readings between 0.02 and 0.03 mrem/h. Along Section A of the railroad tracks and the TSF-06 drainage ditch (Area 6) readings of greater than 0.04 mrem/h were found.

In 1993, four composite surface soil samples, 0 to 1.5 m (0 to 0.5 ft) were collected from along the railroad tracks in Area 1. The area sampled extended from the drainage ditch leading to the TSF-29 pond north to where the railroad tracks cross the road. The samples, each composed of four subsamples collected along a transect 30.5-m (100-ft) long 4.6 m (15 ft) east of the railroad tracks, were analyzed for gross alpha activity, gross beta activity, and gamma-emitting radionuclides. Activities of Cs-137 and Co-60 in the four samples ranged from 4.38 to 16.3 pCi/g and minimum detectable activity to 1.08 pCi/g, respectively. Gross beta activities ranged from 27 to 57 pCi/g. Three surface grab samples were also collected from the soil 0.6 to 0.8 m (2 to 2.5 ft) below the railroad tracks in the portion of track bordering Area 1 on the west. Cs-137 was detected in the three samples (from what was designated Area 13a in the Track 2 investigation) at activities ranging from 0.43 to 3.99 pCi/g. Concentrations of mercury in the three samples from Area 13a ranged between 0.18 and 9.4 mg/kg.

In addition to the surface sampling, shallow drilling and sampling was conducted at six locations as part of the investigation. The subsurface samples were obtained at the resin beads locations, northeast corner of TSF-06, and four borings in the ditch. The sample locations were biased toward hot spots, areas of concern, and/or geophysical anomalies with the depths of the borings being 0 to 1.5 m bgs (0 to 5 ft) with the exception of one boring in the resin beads area which was drilled to 2.2 m (7 ft). Field screening data from the borings detected no alpha radiation, no VOCs above prescribed action levels, no mercury contamination, and no beta/gamma concentrations above 100 cpm. Analytical results from the subsurface samples detected no concentrations for gross alpha contamination at any of the soil boring areas, and no concentrations above background for beta/gamma contamination.

4.1.5.2.3 Nature and Extent of Contamination—Based on the sampling results of the Track 2 investigation, the surficial boundary dimensions of Area 1 are estimated to be approximately 183 by 122 m (600 by 400 ft) [22,325 m^2 (240,000 ft^2)] (LIMTCO 1994). The depth of the radioactively contaminated interval at the site is conservatively estimated to be 10 ft because there is no evidence

contamination being present other than that found in the surficial soils. In addition to the anecdotal reports of buried debris at the site, it is known that two radioactive waste lines run parallel to the roadway west of TAN-607 at a depth of approximately 5 ft according to a 1982 report, although the actual depth may be different. Although there is no evidence that these now-abandoned waste lines leaked, they do represent a potential subsurface source of contamination at the site. The assumption that the concentrations of radioactive contaminants detected at the surface are the same at 3 m (10 ft) bgs is conservative. If contamination is present at the site as a result of windblown deposition or from runoff from contaminated equipment stored uncovered in the area, the highest concentrations of contaminants would be expected in the surface soils. Figure 4-11 shows the extent of contamination at the site as well as the source-term volumes and assumptions upon which the extent and volume estimates are based.

The COPCs for Area 1, based on the contaminant screening process detailed in Section 6 and Table B-5, are shown in Table 4-5.

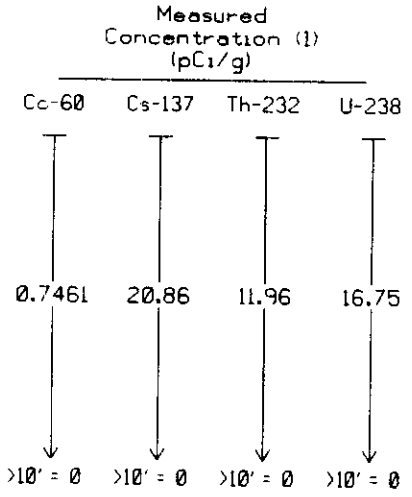
4.1.5.3 Area 9, Northeast Corner Soil Contamination.

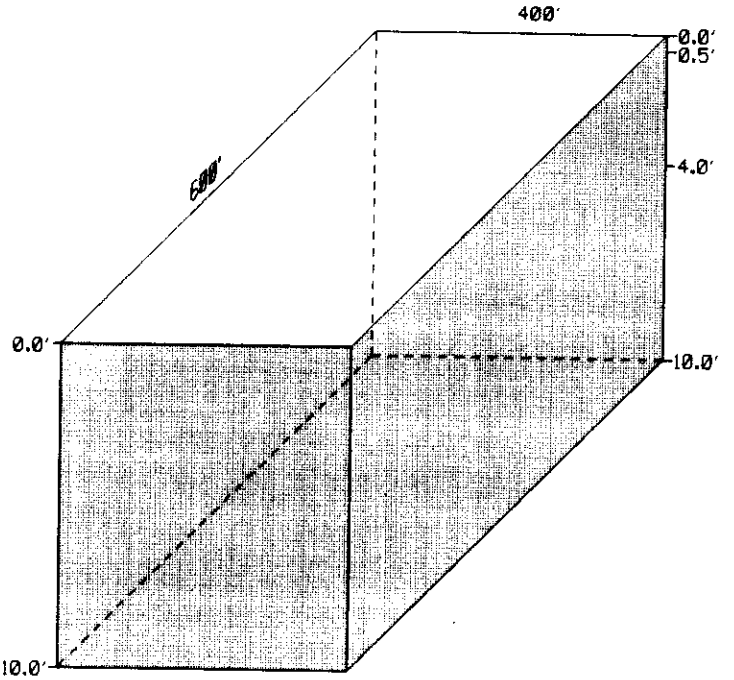
4.1.5.3.1 Site Summary—Area 9 is a small area north of Yukon Avenue with radioactively contaminated soil (see Figure 4-10). Located near a truck loading dock, contamination in the area is probably a result of spillage of radioactive liquids during loading operations. It measures approximately 27.4 by 7.9 m (90 by 26 ft). On the basis of the 1993 sampling and analysis results for the TSF-09 V-tanks, the contaminants expected to be associated with Area 9 (LMITCO 1994) would be radionuclides (primarily Cs-137, Co-60, Sr-90), metals (especially mercury and cadmium) and organic compounds (primarily trichloroethane and tetrachloroethene).

4.1.5.3.2 Previous Investigations—In a 1992 radiation survey of Area 9, concentrated radioactive particles were detected and the beta/gamma radiation readings taken at the surface of the soil ranged from 0.1 to 60 mrem/h (LMITCO 1994). A shallow soil boring to 1.7 m (5.7 ft) bgs was drilled in Area 9 as well. Field screening for beta/gamma radiation, volatile organic vapors, and mercury vapors was performed during drilling. Only the surface sample was retained for laboratory analysis (gross alpha/beta and gamma spectroscopy) because no contamination was detected during field screening. Elevated activities of beta radiation 1,880.0 ± 15.0 pCi/g and Cs-137 (809.0 ± 57.6 pCi/g) were detected in the surface grab sample from Area 9. Area 9 is also included in OU 10-06 radionuclide-contaminated soils at the INEEL. In 1995 a field radiation survey was performed in Area 9 using a sodium iodide (NaI) scintillometer to map beta/gamma radiation levels in the area. Locations contaminated above the OU 10-06 preliminary remediation goals (PRGs) of 16.7 pCi/g were of 16.7 pCi/g for Cs-137 were remediated during the 1996 OU 10-06 removal action. Approximately 150 yd^3 were removed from this area. Two confirmation samples were collected and analyzed for gamma emitting radionuclides. Activities in the two samples were below PRGs at 0.2 and 4.1 pCi/g Cs-137.

4.1.5.3.3 Nature and Extent of Contamination—Based on the verification sampling results and given the reported source of contamination at the site (occasional small spills during loading of radioactive liquids) the contamination at the site has been successfully removed. The surficial extent of contamination as defined by previous radiation surveys in the area is estimated to be limited to a roughly rectangular area measuring 27 by 8 m (90 by 26 ft). The OU 10-06 removal action verification soil sampling and analysis, results were used to define the residual nature and extent of contamination remaining at the site. Risks presented by that contamination was evaluated under this RI/BRA. Figure 4-12 shows the assumptions for the nature and extent of contamination was well as the source-term estimate for TSF-06, Area 9. Depth of residual contamination was assumed to be confined to surficial soil.

TSF-06, Area 1





Exposure Point Concentration (2) (pCi/g)					
Receptor/Pathway	Depth	Co-60	Cs-137	Th-232	U-238
Occ (3) - Air	0-0.5'	0.7461	20.86	11.96	16.75
Occ (3) - External Rad.	0-4'	0.7461	20.86	11.96	16.75
Res (4) - All	0-10'	0.7461	20.86	11.96	16.75
Res (4) - Groundwater	0>10'	0.7461	20.86	11.96	16.75

LEGEND

Zone of contamination for Cs-137, Co-60, Th-232, and U-238.

ASSUMPTIONS:

- Contamination assumed uniform across the site area and extrapolated from surface (0 m (0 ft) to .15 m (0.5 ft) bgs) samples.
- The zone of contamination is conservatively assumed from the surface to 3.05 m (10 ft) bgs because contamination may be attributed to windblown deposition, runoff, and potential migration from buried waste and pipelines in the area.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

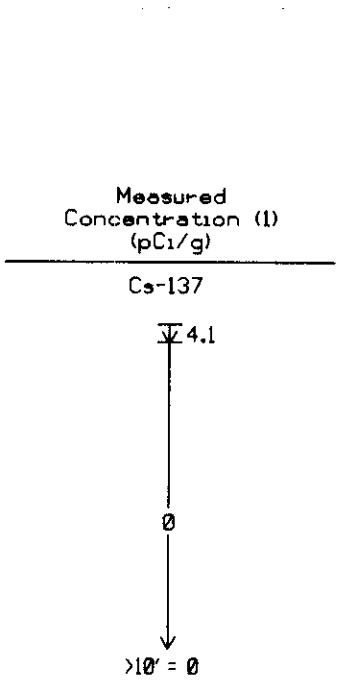
(4) Residential Scenario.

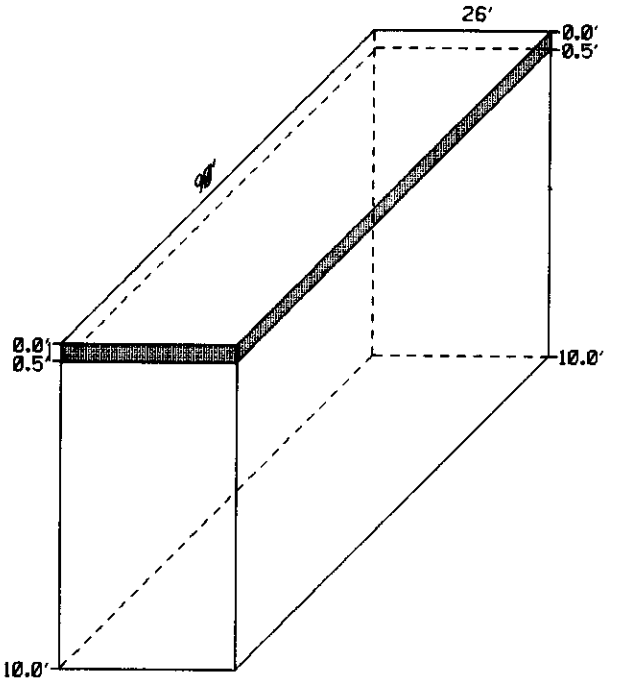
Figure 4-11. OU 1-05: TSF-06, Area 1, nature and extent assumptions.

Table 4-5. Summary statistics for TSF-06 Area 1.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.029	4.1 +/– 0.2	4.28E–01	8.22E–01	35	35	100%	—	NA
Cs-137	0.39	31.5 +/– 2	1.04E+01	7.69E+00	48	48	100%	1.28	14
Th-232	8	17 +/– 1.1	1.15E–01	1.65E+00	40	40	100%	2.1	11
U-238	13 +/– 0.9	19 +/– 1.3	1.64E+01	1.14E+00	40	40	100%	1.85	7

TSF-06, Area 9





Exposure Point Concentration (2) (pCi/g)		
Receptor/Pathway	Depth	Cs-137
Occ (3) - Air	Ø-0.5'	4.1
Occ (3) - External Rad.	Ø-4'	Ø.512
Res (4) - All	Ø-10'	Ø.205
Res (4) - Groundwater	Ø>10'	4.1

LEGEND

Zone of contamination for Cs-137.

ASSUMPTIONS:

- The area of potential residual contamination is conservatively assumed to be the area of the site subject to the 10-06 removal.
- The zone of potential residual contamination is assumed from the surface to .15 m (0.5 ft) bgs due to the removal action.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-12. TSF-06, Area 9, nature and extent assumptions.

The COPC for Area 9, based on the contaminated screening process detailed in Section 6 and Table B-10, are shown in Table 4-6.

4.1.5.4 Area 12, Resin Bead Burial Site.

4.1.5.4.1 Site Summary—The 1993 geophysical survey indicated the presence of scattered shallow metallic material approximately 36.6 m (120 ft) east and 51.8 m (170 ft) north of the buried reactor cores in the location where spent ion-exchange resin beads are suspected of having been buried (LMITCO 1994). The resin beads were from ion-exchange units used to remove radioactivity from fuel storage pool water. Reportedly the resin beads were later dug up and disposed of at the RWMC. Known as Area 12, the site is marked by metal posts and chains placed at the site after the resin beads were dug up and the site restored. It is estimated to be approximately 18.3 m (60 ft) long and 15.2 m (50 ft) wide on the basis of the geophysical survey results (see Figure 4-10). The COPCs associated with the site are those that the resin beads were designed to remove from the water: Cs-137, Co-60, and Sr-90.

4.1.5.4.2 Previous Investigations—The site was characterized during the Track 2 investigation with two borings (LMITCO 1994). A borehole sample within the top 1.5 m (5 ft) was collected along with a duplicate. The samples were submitted to a laboratory for gross alpha and beta analyses. Subsurface samples below 1.5 m (5 ft) were not collected because no evidence of organic, mercury, or radioactive contamination was detected during field screening. The Track 2 concluded no evidence of buried resin beads was found at the site. The Track 2 also concluded that the site posed no risk and required no further evaluation.

4.1.5.4.3 Nature and Extent of Contamination—The sampling and analysis results upon which the contaminant screening is based are from the analysis of one borehole sample. The depth at which the resin beads were buried is unknown, no evidence of contamination or resin beads in the two borings drilled at the site to a depth of 1.5 m (5 ft) (LMITCO 1994).

No COPCs were identified for Area 12 during the contaminant screening process detailed in Section 6.

4.1.5.5 Area 3, TAN-781 Pond.

4.1.5.5.1 Site Summary—This unlined surface pond (Area 3) northeast of the RPSSA was excavated in 1959 and reportedly has always been dry (LMITCO 1994). The pond measures 21.3 by 33.5 m (70 by 110 ft) and has ditches entering it from the east and south. Area 3 is shown on Figure 4-13. The potential sources of contamination to the pond would be limited to the incidental occurrence of contaminated surface water from run-off and windblown deposition of contaminants from other areas within TSF-06. This implies that contamination, if present, would be greatest at the surface and most likely occur in the ditches entering the pond. Radionuclides (Cs-137, Co-60, and Sr-90) are the most consistent contaminants detected in the TSF area and are the ones most likely to have migrated to the pond in run-off or through wind erosion.

4.1.5.5.2 Previous Investigations—In May 1993, the pond and 15.2 m (50 ft) of the ditches entering the pond were surveyed for beta/gamma radiation using a portable Ludlum 2A meter. No radiation measurements collected in the pond or ditches were greater than background levels (LMITCO 1994). Two surface grab samples were collected from within the outfall of the two ditches during the Track 2 investigation. The samples were sent to the analytical laboratory for gross alpha, gross beta and

Table 4-6. Summary statistics of TSF-06 Area 9.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Cs-137	809 +/– 57.6	809 +/– 57.6	8.09E+02	NA	1	1	100%	1.28	1

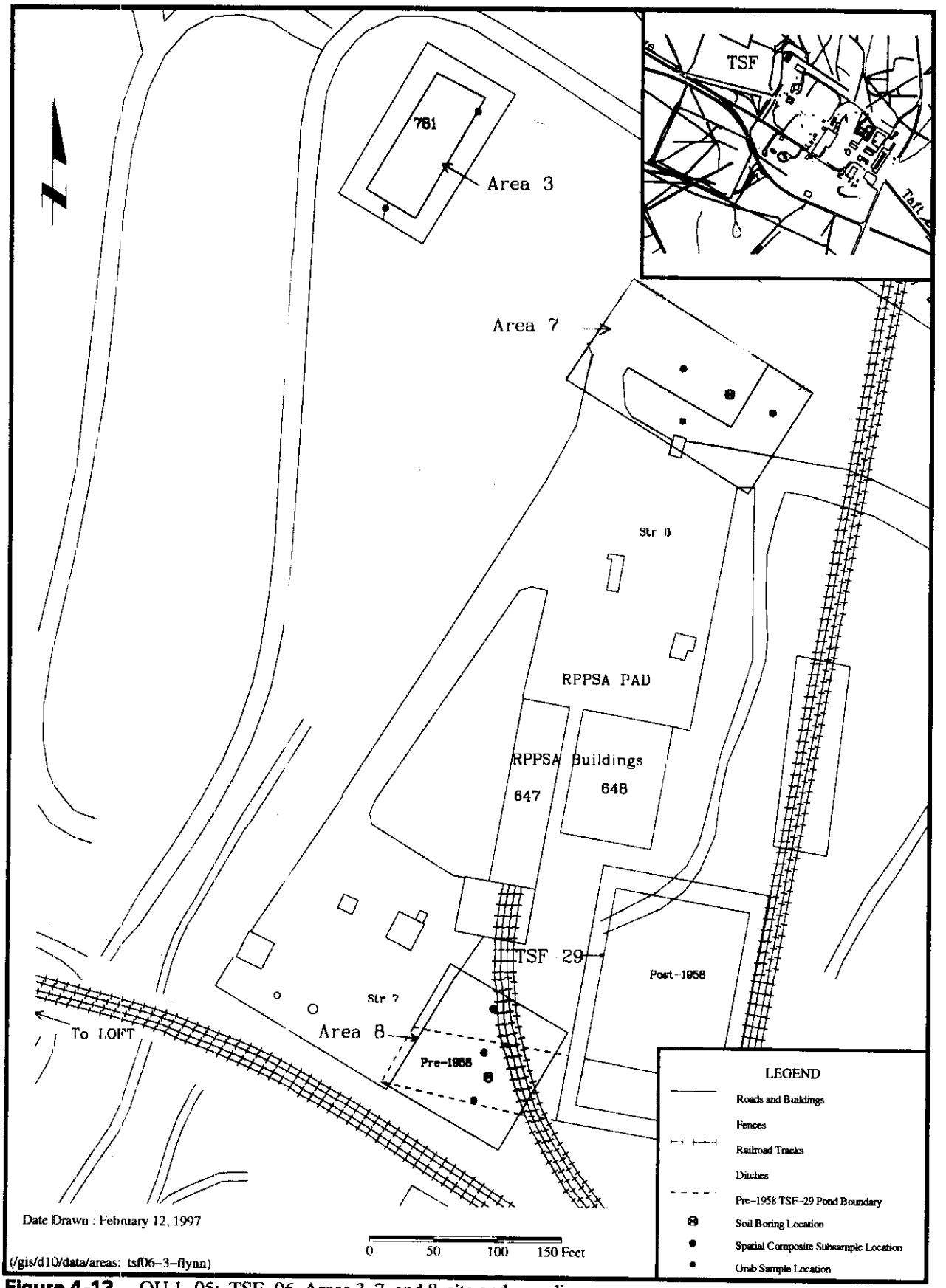


Figure 4-13. OU 1–05: TSF–06, Areas 3, 7, and 8, site and sampling map.

gamma spectroscopy analysis. The sample from the south ditch outfall was also subject to alpha spectroscopy analyses. The gross alpha and beta and Cs-137 activities detected in the samples were consistent with background levels of radioactivity in surface soils at the INEEL (LMITCO 1994). The Am-241 activity detected in the south ditch outfall sample, during the alpha spectroscopy analysis is slightly elevated over surface soil background activities on the INEEL.

4.1.5.5.3 Nature and Extent of Contamination—Based on the sampling results of the Track 2 investigation, the depth that contamination would be expected, if present, is limited to surface soils [0 to 0.1 m (0 to 0.5 in.)] in the pond (LMITCO 1994). The assumption that contamination is limited to the first 0.1 m (6 in.) in the pond is conservative because no evidence of contamination was detected in surface soils during field screening. The Am-241 activity detected during sample analysis is relatively low (close to the expected background level). The field screening was inclusive of the entire pond and ditches entering the pond the sampling was biased toward areas where contamination would be most likely; where water would have entered the pond. The surficial extent of contamination at the site, based on the two surface grab samples is estimated to be the size of the pond itself, 21.3 by 30.5 m (70 by 100 ft). Figure 4-14 shows the extent of contamination at the site as well as the source term volumes and assumptions upon which the extent and volume estimates are based.

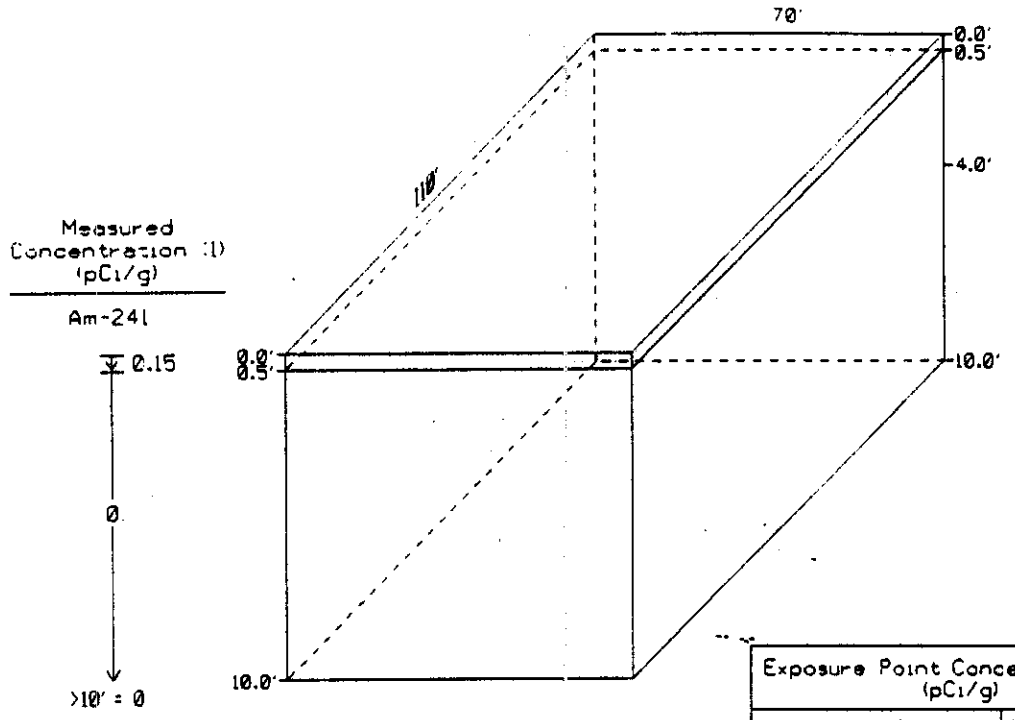
The COPCs for Area 3, based on the contaminant screening process detailed in Section 6 and Table B-6, is shown in Table 4-7.

4.1.5.6 Area 7, Soil Box Storage.

4.1.5.6.1 Site Summary—Area 7 is a small area north of Yukon Avenue with radioactively contaminated soil (see Figure 4-14) (LMITCO 1994). Contaminated soil boxes and lead were stored in Area 7 from the mid-1970s to the mid-1980s. Area 7, located against the fence in the northwest corner of TSF, measures approximately 45.7 by 60.9 m (150 by 200 ft) in size. On the basis of the history of the site as an open-air storage unit for radioactively contaminated lead and boxes, expected contaminants associated with the site are metals (especially lead and mercury) and radionuclides (Cs-137, Co-60, and Sr-90) that were removed from stored items as a result of exposure to precipitation or wind.

4.1.5.6.2 Previous Investigations—During a 1993 mobile radiation survey of the area concentrated radioactive particles were detected and the beta/gamma readings at the soil surface ranged from 0.12 to 19.5 mrem/h. During the 1993 Track 2 investigation, one composite surface soil sample composed of three subsamples was collected from Area 7. A shallow soil boring to 1.7 m (5.7 ft) bgs was drilled in Area 7 as well. Field screening for beta/gamma radiation, volatile organic vapors, and mercury vapors was performed during drilling of the boring. A sample from the soil surface at the boring location and a vertical composite sample from the entire borehole, from 0 to 1.7 m (0 to 5.7 ft), were collected. In the radiochemical analysis of the duplicate composite sample from Area 7, Co-60 and Cs-137 were detected at maximum activities of 1.61 pCi/g and 73.0 ± 5.4 pCi/g, respectively. The maximum gross alpha and gross beta activities were 16.0 ± 4.0 pCi/g and 151 ± 4.0 pCi/g. Concentrations of metals in the sample appear to be consistent with background concentrations of metals in INEEL surface soils. In the analysis of the surface grab and composite boring samples from Area 7, radionuclide activities were consistent with background levels (LMITCO 1994).

Area 7 was also included in OU 10-06 radionuclide-contaminated soils at the INEEL. In 1995, a field radiation survey was performed in Area 7 using a NaI scintillometer to map beta/gamma radiation levels in the area. Locations contaminated above OU 10-06 PRGs were remediated during the 1996



Exposure Point Concentration (2) (pCi/g)		
Receptor/Pathway	Depth	Am-241
Occ (3) - Air	0-0.5'	0.15
Occ (3) - External Rad.	0-4'	0.0375
Res (4) - All	0-10'	0.015
Res (4) - Groundwater	0>10'	0.015

LEGEND

Zone of contamination for Am-241.

ASSUMPTIONS:

- The area of contamination is conservatively assumed to be the area of the site. Results for one sample were extrapolated across the site.
- The zone of contamination is limited to Am-241 in the top .15 m (0.5 ft) based on one sample result.
- All other depth intervals assumed to be 0 concentration.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-14. OU 1-05: TSF-06, Area 3, nature and extent assumptions.

Table 4-7. Summary statistics for TSF-06 Area 3.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Am-241	0.15 +/– 0.03	0.15 +/– 0.03	1.50E–01	NA	1	1	100%	0.019	1

OU 10-06 removal action. Approximately 150 yd^3 were removed from the area and the area was backfilled an contoured to grade. Two verification samples were collected prior to backfilling and analytical results indicate residual contamination is below the 16.7 pCi/g PRG for Cs-137.

4.1.5.6.3 Nature and Extent of Contamination—Based on the verification sampling results, the surficial extent of contamination is estimated to be limited to the area defined as the storage site and measures 45.7 by 60.9 m (150 by 200 ft) in size (LMITCO 1994). Contamination is expected to be limited to surface soils 0 to 0.15 m (0 to 0.5 ft) bgs because the area has been subject to a removal. The residual nature and extent of contamination remaining at the sites was evaluated under this RI/BRA and is based on the verification samples results. Figure 4-15 shows the assumptions for the nature and extent of contamination as well as the source-term estimate for Area 7.

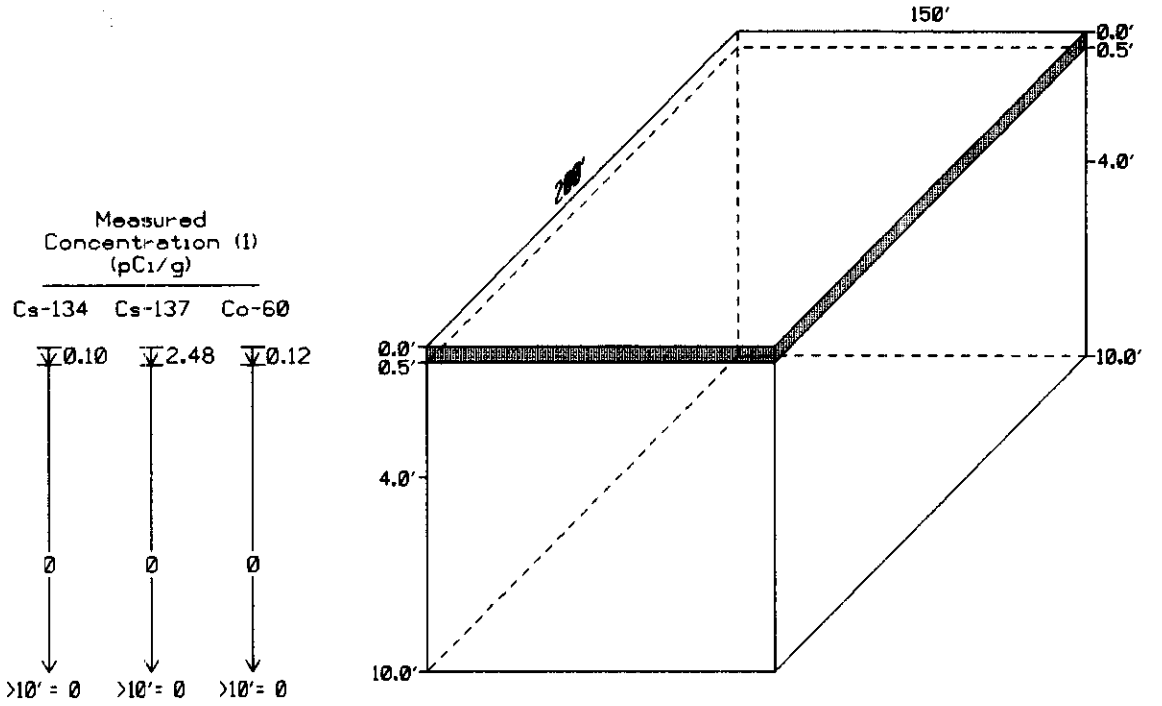
The COPCs for Area 7, based on the contaminant screening process detailed in Section 6 and Table B-8, are shown on Table 4-8.

4.1.5.7 Area 8, Cask Storage Pad/TSF-29 Pre-1958 Pond.

4.1.5.7.1 Site Summary—Area 8 is the only area northwest of the railroad turntable identified during the Track 2 investigation as a potential problem. Approximately 38 by 38 m (125 by 125 ft) in size, the site was a storage pad where four ANP reactor casks were stored from 1959 to the early 1980s (LMITCO 1994). Approximately 12.2 m (40 ft) of the area is covered by a concrete pad and is now part of the RPSSA, an active co-located facility (see Appendix D). Reactor casks are used to transport core components and as a result may become contaminated by dust or particles from the components. Decontamination or opening of the casks at the cask storage site would have resulted in surface contamination. Probable contaminants associated with operations in Area 8 would be primarily radionuclides such as Cs-137, Co-60, and Sr-90. Area 8 also encompasses a portion of the TSF-29 pond designated the pre-1958 pond backfill and sediment. The pre-1958 pond, approximately 9.1 by 45.7 m (30 by 150 ft) in area, was constructed to receive the runoff of surface water from the northwest quadrant of TSF. Surface water flowed into the pond through the TSF-06 ditch. Sometime after 1958, the pond was backfilled and a new pond was excavated to the northeast to allow railroad access to two new buildings, TAN-647 and-648, that were to house the large aircraft dollies. This portion of the railroad, designated Section B in the Track 2 investigation, still runs through Area 8. Approximately 9.1 to 15.2 m (30 to 50 ft) of the pre-1958 pond is now covered by a concrete pad and is now part of the RPSSA, an active co-located facility (see Appendix D). The principal contaminants thought to be associated with the pond are primarily metals and radionuclides, although some organic compounds may have been disposed of in the pond in waste and surface water flowing to the pond.

4.1.5.7.2 Previous Investigations—In 1993 a radiation survey of the pre-1958 pond was performed. Background radiation in the area was 0.015 mR/h. The survey indicated an elevated radiation field in the southwest corner of the RPSSA near the concrete pad used to store the ANP casks and near the pre-1958 pond. Eleven hot spots within the pre-1958 pond were also pinpointed with beta/gamma activities ranging from 0.44 to 31.7 mR/h. To characterize contamination in the cask storage area and the pre-1958 pond, one boring to 2.2 m (7.2 ft) was drilled and sampled and a surface soil composite sample was collected during the Track 2 investigation. The boring was located within both the pre-1958 pond and Area 8. One of the three subsamples for the composite sample was collected in the area where the pre-1958 pond and Area 8 overlapped, the other two subsamples were within Area 8, at locations north and south of the pre-1958 pond. A surface grab sample was collected at the boring location, and a sample from soil that was composited from 0.1 to 2.3 m (0.5 to 7.5 ft) also was collected. Both samples were submitted to an on-Site analytical laboratory for gross alpha, gross beta, and gamma spectroscopy analyses. In

TSF-Ø6, Area 7



Exposure Point Concentration (2) (pCi/g)				
Receptor/Pathway	Depth	Cs-134	Cs-137	Co-60
Occ (3) - Air	Ø-Ø.5'	Ø.1Ø	2.48	Ø.12
Occ (3) - External Rad.	Ø-4'	Ø.Ø12	Ø.31	Ø.Ø15
Res (4) - All	Ø-1Ø'	Ø.ØØ5	Ø.124	Ø.ØØ6
Res (4) - Groundwater	Ø>1Ø'	Ø.1Ø	2.48	Ø.12

LEGEND

Zone of contamination for Cs-134, Cs-137, and Co-60.

ASSUMPTIONS:

- The area of potential residual contamination is conservatively assumed to be the area of the site subject to the 10-06 removal.
- The zone of potential residual contamination is assumed from the surface to 0.15 m (0.5 ft) bgs due to the removal action.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-15. OU 1-05: TSF-06, Area 7, nature and extent assumptions.

Table 4-8. Summary statistics for TSF-06 Area 7.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.12 +/– 0.02	0.12 +/– 0.02	0.12	NA	1	1	100%	—	NA
Cs-134	0.1 +/– 0.03	0.1 +/– 0.03	0.1	NA	1	1	100%	—	NA
Cs-137	1.9 +/– 0.14	2.48 +/– 0.19	2.19	0.41	2	2	100%	1.28	2

addition, alpha spectroscopy and Sr-90 analyses were performed on the surface composite sample. The results of the gross alpha, gross beta gamma spectroscopy, and alpha spectroscopy analyses indicate extensive Cs-137, Co-60, and Sr-90 contamination in the surface soils at the site. The field screening data for this boring indicated only two samples collected at a depth less than 0.3 m (1 ft) had elevated levels; beta/gamma radiation was reported as 900 and 2,000 cab in these samples. In the analysis of the boring vertical composite, Cs-137 was detected at 19.3 pCi/g. Gross alpha and gross beta activities were 23 pCi/g and 64 pCi/g, respectively (LMITCO 1994). In 1995 a field radiation survey was performed in Area 8 using a NaI scintillometer to map beta/gamma radiation levels in the area. Locations contaminated above the OU 10-06 PRGs will be remediated during the 1996 OU 10-06 removal action.

4.1.5.7.3 Nature and Extent of Contamination—Based on the verification sampling results for the post-removal area, the depth of contamination at the site is estimated to be limited to surface soils 0 to 1.5 m (0 to 0.5 ft) bgs based on observations made during the removal action. The surficial extent of contamination is defined by previous (i.e., preremoval) radiation surveys in the area and is estimated to be limited to an area measuring 38.1 by 29.9 m (125 by 85 ft), adjacent to the concrete pad in the RPSSA. Contamination in the pre-1958 pond is a result of discharge to the pond as well as the use of contaminated materials to backfill the pond. This area was also surveyed during the OU 10-06 removal and soil above PRGs (i.e., 16.7 pCi/g Cs-137) was removed. Locations contaminated above the PRGs of 16.7 pCi/g for Cs-137 and 66.2 pCi/g for Sr-90 were remediated during the 1996 OU 10-06 removal action. The areal extent of this contaminated zone is estimated to be 30.5 by 9.1 m (100 by 30 ft), the size of the pond minus the portion below the concrete pad in the RPSSA. The residual nature and extent of contamination at Area 8 and the pre-1958 pond and risks presented by that contamination were evaluated under this RI/BRA based on the verification sample results. Figure 4-16 shows the assumptions for the nature and extent of potential residual contamination as well as the source-term estimates.

The COPCs for Area 8, based on the contaminant screening process detailed in Section 6 and Table B-9, are shown in Table 4-9.

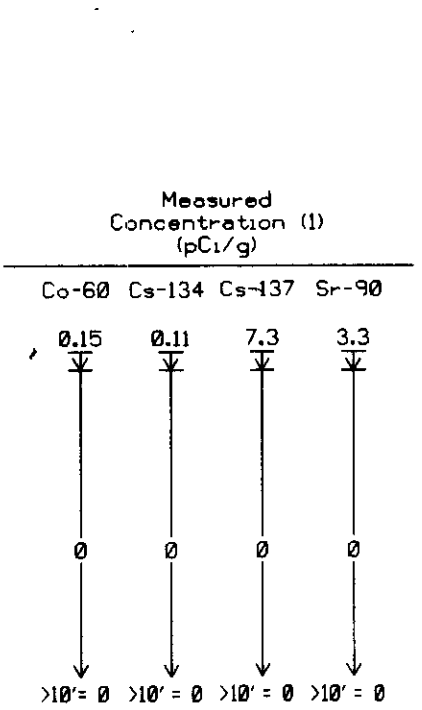
4.1.5.8 Area 5, Radioactive Soil Berm.

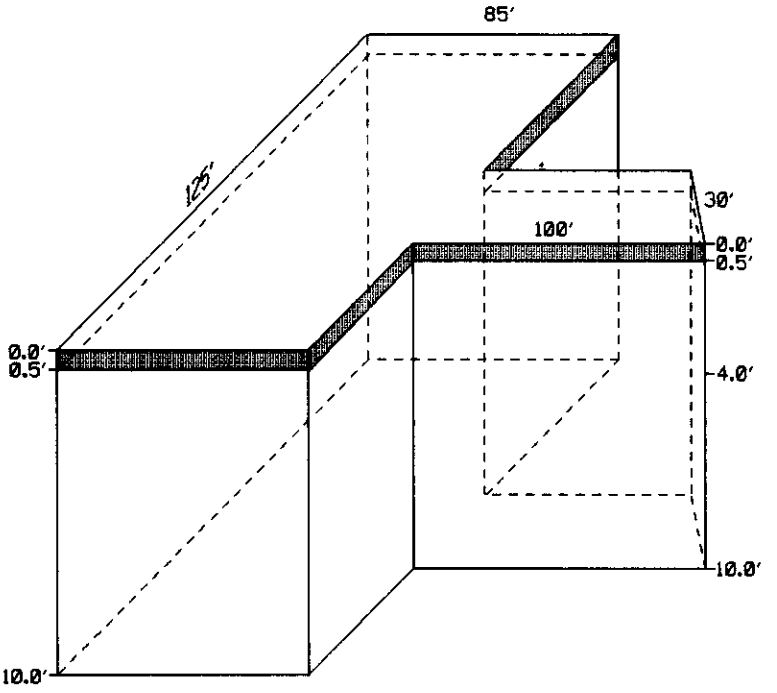
4.1.5.8.1 Site Summary—The Area 5 soil berm measures approximately 0.9 m (3 ft) high, by 45.7 m (150 ft) long, and by 3 m (10 ft) wide as shown in Figure 4-17. This may be the berm created in 1986 when a 137 m^2 (5,000 ft^2) area in the southeast portion of TSF-06 was scraped clean to allow construction of two new storage pads (LMITCO 1994). The most probable contaminants associated with the berm are primarily radionuclides (Cs-137, Co-60, and Sr-90) and mercury in the surface soils used to create the berm. These are the contaminants most commonly detected in association with radioactive processes at TAN and in sampling events at other areas within TSF-06.

4.1.5.8.2 Previous Investigations—During the 1993 Track 2 investigation, three surface samples were obtained by gridding the berm into three grids and collecting and compositing three subsamples from each grid. The results of the gamma spectroscopy and gross alpha and beta analyses of the samples indicate Cs-137 activities ranged from 11 ± 0.8 to 13.4 ± 1.0 pCi/g. The maximum gross alpha and beta activities detected were 26.0 ± 4.0 pCi/g and 40.0 ± 3.0 pCi/g, respectively (LMITCO 1994).

4.1.5.8.3 Nature and Extent of Contamination—The depth of the radioactively contaminated interval at the site is estimated to be the height of the berm 0.9 m (3 ft) because there are no sampling and analysis results defining the depth of contamination (LMITCO 1994). This is a conservative estimate based on the assumption that all of the soil in the berm is radioactively contaminated at

TSF-Ø6, Area 8





Exposure Point Concentration (2) (pCi/g)					
Receptor/Pathway	Depth	Co-60	Cs-134	Cs-137	Sr-90
Occ (3) - Air	Ø-Ø.5'	Ø.15	Ø.11	7.3	3.3
Occ (3) - External Rad.	Ø-4'	Ø.Ø19	Ø.Ø14	Ø.91	Ø.41
Res (4) - All	Ø-10'	Ø.ØØ8	Ø.ØØ6	Ø.36	Ø.16
Res (4) - Groundwater	Ø>10'	Ø.15	Ø.11	7.3	3.3

LEGEND

Zone of contamination for Co-60, Cs-134, Cs-137, and Sr-90.

ASSUMPTIONS:

- The area of potential residual contamination is conservatively assumed to be the area of the site subject to the 10-06 removal.
- The zone of potential residual contamination is assumed from the surface to .15 m (0.5 ft) bgs due to the removal action.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-16. OU 1-05: TSF-06, Area 8, nature and extent assumptions.

Table 4-9. Summary statistics for TSF-06 Area 8.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.15 +/- 0.02	0.15 +/- 0.02	0.15	NA	1	1	100%	—	NA
Cs-134	0.11 +/- 0.3	0.11 +/- 0.3	0.11	NA	1	1	100%	—	NA
Cs-137	1.6 +/- 0.2	7.3 +/- 0.5	4.36	2.05	5	5	100%	1.28	4
Sr-90	2.7 +/- 0.6	3.3 +/- 0.8	3.07	0.32	3	3	100%	0.76	3

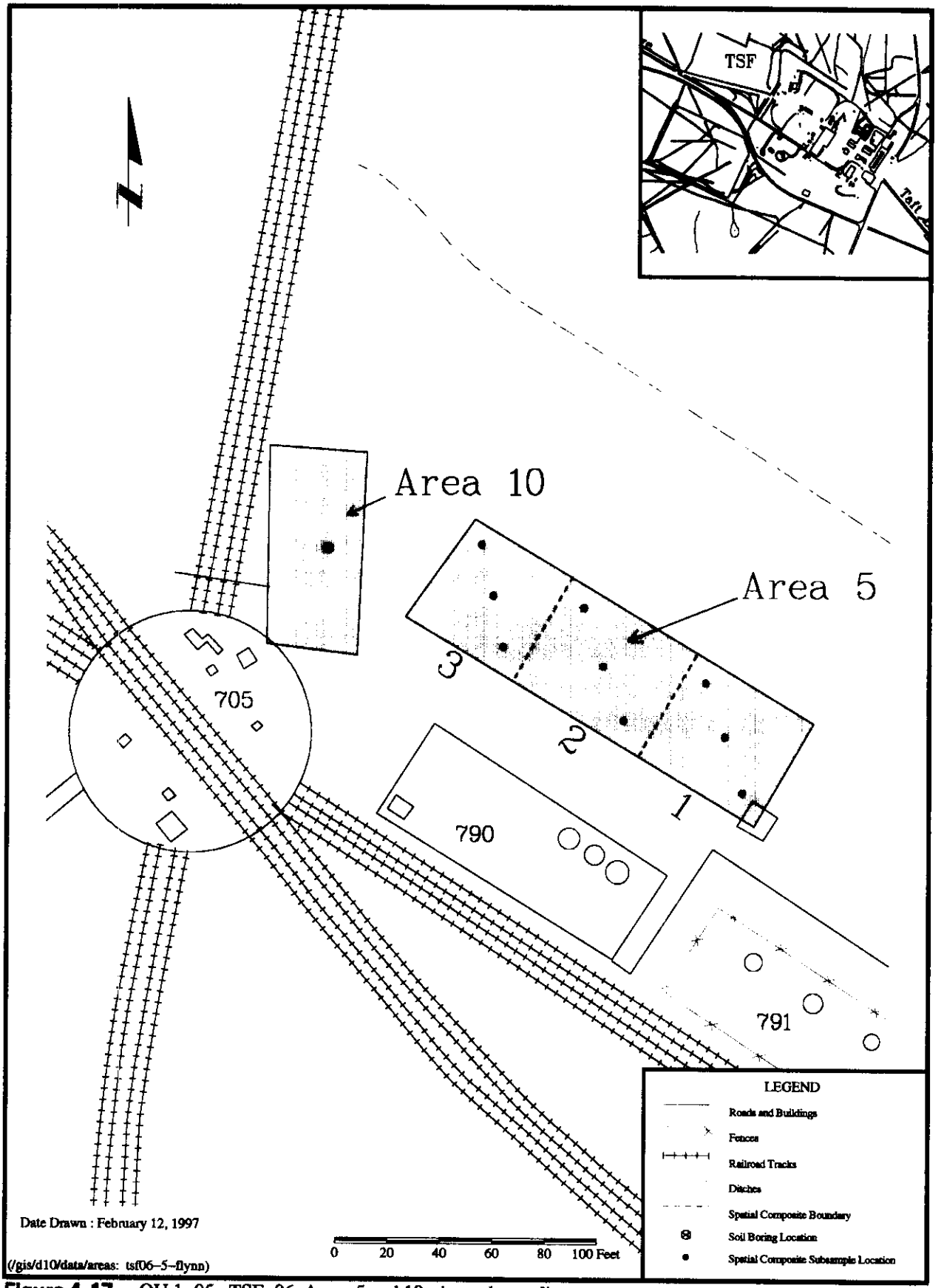


Figure 4-17. OU 1–05: TSF–06, Areas 5 and 10, site and sampling map.

concentrations detected at the surface. Figure 4-18 shows the assumptions for the nature and extent of contamination at the site as well as the source-term estimate for Area 5.

The COPCs for Area 5, based on the contaminant screening process detailed in Section 6 and Table B-5, are shown in Table 4-10.

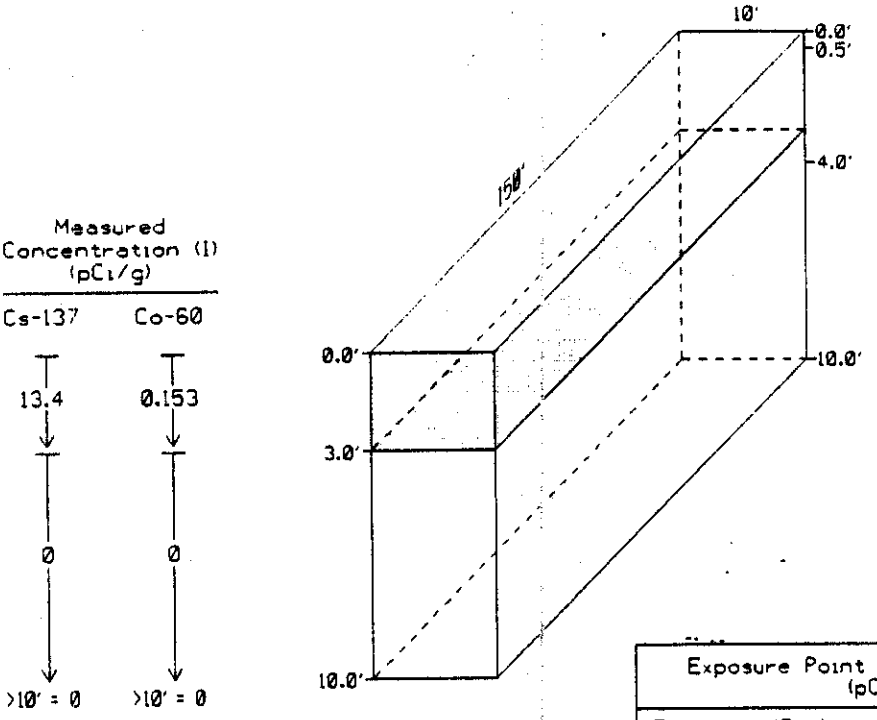
4.1.5.9 Area 10, Reactor Vessel Burial Site.

4.1.5.9.1 Site Summary—Area 10, just northeast of the railroad turntable, is where two reactor vessel storage units are buried (see Figure 4-17). One of the units contains an empty irradiated reactor core vessel. The storage units are large metallic underground storage tanks (USTs) buried on end with a large opening cut into the tank end wall at the ground surface. These metallic storage tanks are at least 3 m (10 ft) deep because the HTRE reactor vessels and shield plugs stored in the units were 3 m (10 ft) in length. When in use, the storage units were covered by small wooden sheds. During the transfer of a reactor vessel into one of the storage units, the vessel fell from the a crane and dropped into the storage unit. Damaged by the fall, the vessel could not be recovered and was buried in place. The depth at which the vessels are buried is unknown, although a 1993 geophysical survey did confirm the presence of two large metallic objects buried at a moderate 3 to 3.6 m (10 to 12 ft) depth bgs (LMITCO 1994). On the basis of the geophysical survey results, Area 10 is estimated to be approximately 15.2 by 15.2 m (50 by 50 ft) in size. Although no information is available concerning the specific contaminants associated with the reactor vessel and storage units, it is likely that the main contaminants present are Cs-137, Co-60, and Sr-90, the radioactive contaminants most commonly found associated with processes at TAN.

4.1.5.9.2 Previous Investigations—The site was characterized during the Track 2 investigation with a single boring. A grab sample from the soil surface at the boring location and a vertical sample from soil composited from the entire borehole from 0 to 1.7 m (0 to 5.7 ft) were collected and sent to an analytical laboratory for gross alpha, gross beta, gamma spectroscopy analyses. The composite sample was also submitted to a laboratory for Contract Laboratory Program (CLP) metals analysis. The results of the Track 2 sample analysis indicate no radioactive contamination in shallow soils at the site above expected background levels (LMITCO 1994).

4.1.5.9.3 Nature and Extent of Contamination—Soils below and around the reactor vessel storage units have not been sampled, making a estimate about the nature and extent of contamination at the site difficult. Generally reactor vessels do not contain radioactive contamination in a form that is easily released. The core vessels become activated during reactor operations and the radioactivity becomes fixed in the vessel structure. Unless the vessel is undergoing corrosion, the radioactivity will not migrate and presents a hazard only as a fixed source of radiation exposure. It is known that the reactor vessel buried in Area 10 is contained in a metallic storage unit, making corrosion and subsequent migration of contaminants even less likely. The radiation levels and specific radionuclides associated with the reactor vessel are unknown, making an estimate of the potential external exposure from the buried vessel to a receptor at the ground surface impossible. In the 1993 mobile beta/gamma radiation field survey, measurements at the burial site were no higher then levels in adjacent areas. The risks associated with the irradiated core vessel will not be evaluated in the BRA because a lack of site-specific information about the core vessels.

No COPCs were identified for the Area 10 site during the contaminant screening process detailed in Section 6 and in Table B-11.



Exposure Point Concentration (2) (pCi/g)			
Receptor/Pathway	Depth	Cs-137	Co-60
Occ (3) - Air	0-0.5'	13.4	0.153
Occ (3) - External Rad.	0-4'	10.05	0.1148
Res (4) - All	0-10'	4.02	0.0459
Res (4) - Groundwater	0>10'	4.02	0.0459

LEGEND

Zone of contamination for Cs-137 and Co-60.

ASSUMPTIONS:

- The area of contamination is assumed to be the site area and uniform across site.
- The zone of contamination is from the surface to a depth of .91 m (3 ft) bgs which corresponds to the depth of the berm.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-18. OU 1-05: TSF-06, Area 5, nature and extent assumptions.

Table 4-10. Summary statistics for TSF-06 Area 5.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.153 +/– 0.02	0.153 +/– 0.02	1.53E–01	NA	1	1	100%	—	NA
Cs-137	11 +/– 0.8	13.4 +/– 0.96	1.25E+01	1.31E+00	3	3	100%	1.28	3

4.1.5.10 Area 11, TSF-06 Ditch.

4.1.5.10.1 Site Summary—The TSF-06 ditch, which runs east-west through TSF-06, originates at the north end of buildings TAN-607, -615, -616, and -633. Area 11 is shown on Figure 4-19. An earthen berm obstructs the flow of water from the TSF-09 area into the ditch (see Section 4.6). The ditch, which empties into the TSF-29 pond, directs storm-water runoff from the TSF-06 site into the pond. The ditch, which is approximately 270 m (900 ft) long, consists of two arms originating in the TSF area. It is the north arm that at one time was intersected by the ditch in TSF-09. On the basis of the 1993 sampling and analysis results for the TSF-09 V-tanks (LMITCO 1994), the contaminants expected to be associated with Area 11 are radionuclides (primarily Cs-137, Co-60, and Sr-90), metals (especially mercury and cadmium), and organic compounds (primarily trichloroethane and tetrachloroethene).

4.1.5.10.2 Previous Investigations—Past radiation surveys indicate substantial beta/gamma contamination in the approximately 270 m (900 ft) of ditch in the TSF-06 site. During a 1983 D&D characterization, two locations within the ditch were sampled. The grab samples were collected from the surface, 12.7 cm (5 in.) bgs and 25.4 cm (10 in.) bgs. At 25.4 cm (10 in.) below the surface, Cs-137 activities were 9.8 $\pm$ 0.1 pCi/g and 114 $\pm$ 0.2 pCi/g, indicating subsurface contamination (Clark and McQuary 1984). During the Track 2 investigation, four shallow borings were placed at locations in the ditch where field screening had indicated elevated beta/gamma activities (LMITCO 1994). Two of these were near the railroad tracks on the east side, and two were on the north arm of the ditch between Bear Boulevard and where the north and south arms of the ditch intersect. Only surface soil grab samples from the four borings were sent to an analytical laboratory for analysis because field screening did not indicate any organic, mercury, or radioactive contamination below the surface. The results of the sample analysis indicate elevated beta, alpha, and gamma radiation in the surface soils of the ditch. Locations contaminated above the OU 10-06 PRGs were targeted for remediation during the 1996 OU 10-06 removal action. Approximately 300 yd^3 were removed from those areas and the area was contoured to grade. Twelve verification samples were collected. Four of the twelve had concentrations in excess of the 10^{-06} PRG of 16.7 for Cs-137.

4.1.5.10.3 Nature and Extent of Contamination—Based on the verification sampling results during the removal action that indicated the elevated levels of contamination were not isolated or concentrated in hot spots, Area 11 remains defined as the entire TSF-06 ditch from where it originates to where it terminates in the TSF-29 pond (LMITCO 1994) for conservatism. Verification soil sampling and analysis results were used to define the residual nature and extent of contamination remaining in the TSF-06 ditch and risks presented by that contamination were evaluated under this RI/BRA. The assumptions for the nature and extent of contamination as well as the source term estimates for Area 11 are illustrated on Figure 4-20.

The COPCs for Area 11, based on the contaminant screening process detailed in Section 6 and Table B-12, are shown in Table 4-11.

4.1.5.11 Area B, Soil Area South of Turntable.

4.1.5.11.1 Site Summary—An open soil, Area B, bound by the facility fence on the west and facility roads on the east and south, is roughly triangular and measures approximately 205.8 m (675 ft) wide on the southern base and 129.6 m (425 ft) high (LMITCO 1994). Area B is shown on Figure 4-21 and the estimated size of the soil area is 165,313 ft^2. Surface soils in the area are radioactively contaminated because of the wind-blown deposition of radioactive particles from the PM-2A tank area,

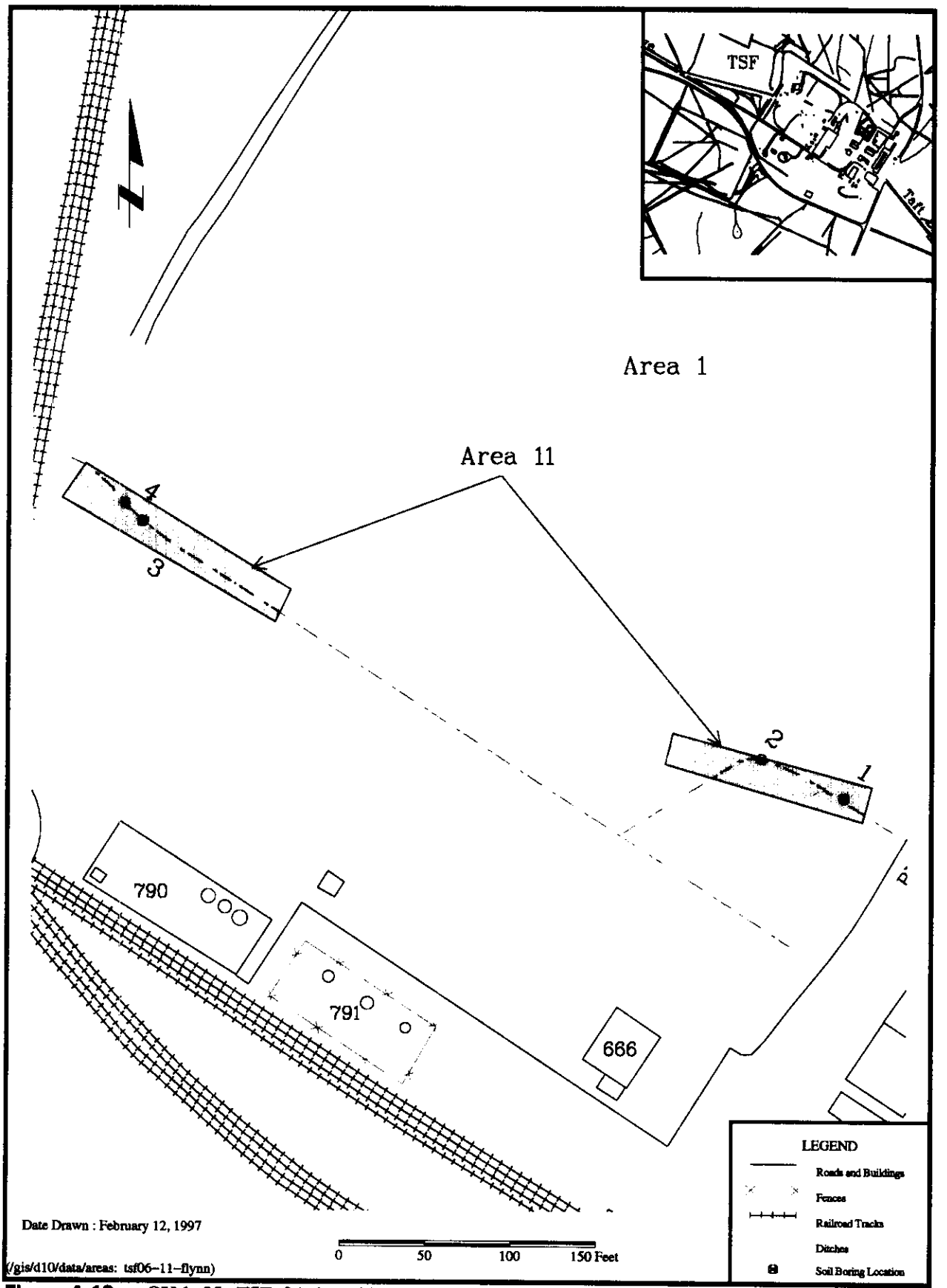
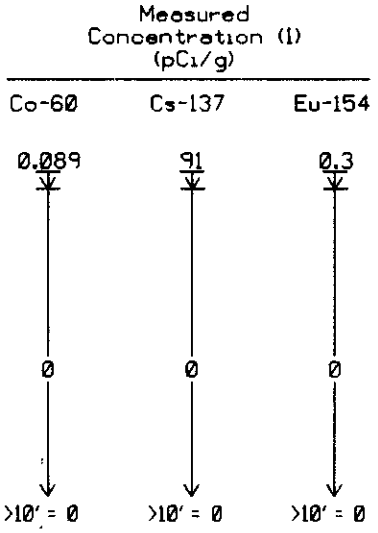
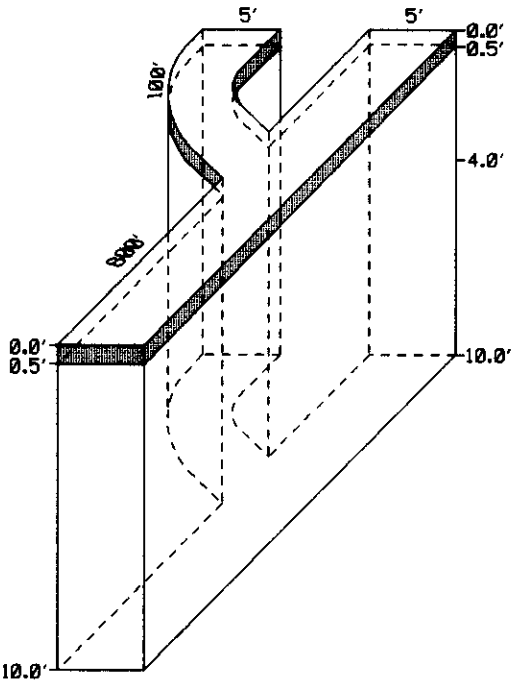


Figure 4-19. OU 1–05: TSF–06, Area 11, site and sampling map.





Exposure Point Concentration (2) (pCi/g)				
Receptor/Pathway	Depth	Co-60	Cs-137	Eu-154
Occ (3) - Air	0-0.5'	0.089	91	0.3
Occ (3) - External Rad.	0-4'	0.011	11.4	0.04
Res (4) - All	0-10'	0.004	4.6	0.015
Res (4) - Groundwater	0>10'	0.089	91	0.3

LEGEND

Zone of contamination for Co-60, Cs-137, and Eu-154.

ASSUMPTIONS:

- The area of potential residual contamination is conservatively assumed to be the area of the site subject to the 10-06 removal.
- The zone of potential residual contamination is assumed from the surface to .15 m (0.5 ft) bgs due to the removal action.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-20. TSF-06, Area 11, nature and extent assumptions.

Table 4-11. Summary statistics for TSF-06 Area 11.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.057 +/– 0.02	0.089 +/– 0.02	0.072	0.016	3	3	100%	—	NA
Cs-137	0.88 +/– 0.08	92 +/– 7	20.94	27.01	12	12	100%	1.28	11
Eu-154	0.3 +/– 0.05	0.3 +/– 0.05	0.3	NA	1	1	100%	—	NA

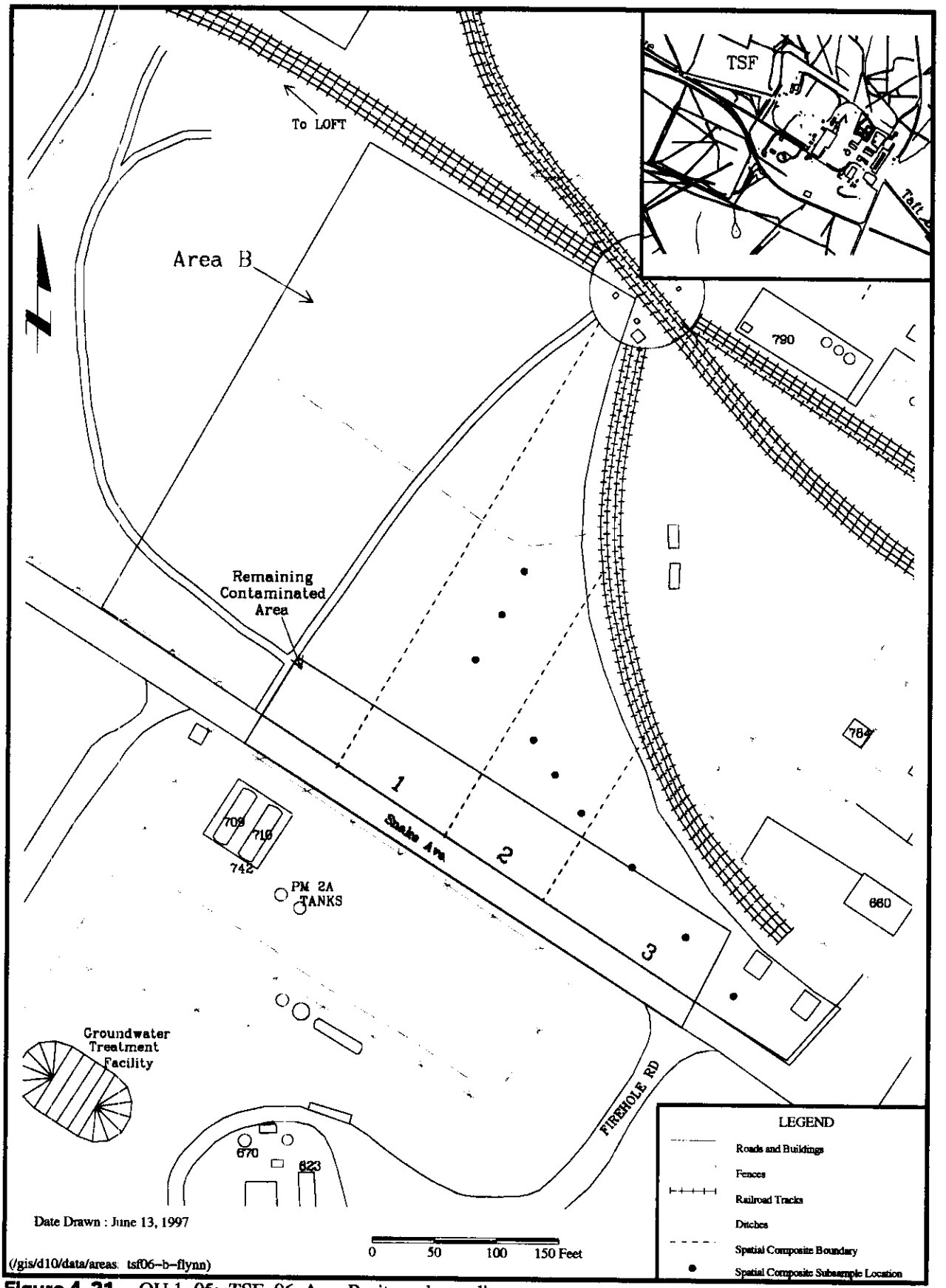


Figure 4-21. OU 1–05: TSF–06, Area B, site and sampling map.

which is south of the site. Although wind direction at TAN can be either from the southwest or from the northeast, a radiological survey conducted in 1980 (LMITCO 1994) indicated that southwest transport of contaminants was insignificant. Primary radioactive contaminants at the site based on site history and sampling and analysis results are Cs-137, Co-60, and Sr-90.

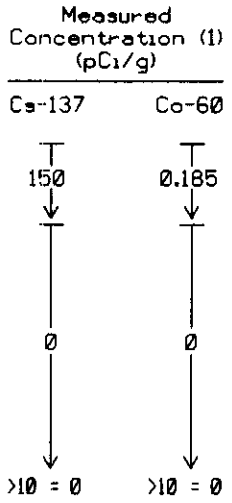
4.1.5.11.2 Previous Investigations—The soil area in Area B was evaluated during the Track 2 investigation using historical data and the results of the radionuclide analysis of composite surface soil samples. The evaluation indicated elevated Cs-137 activities in the soils (LMITCO 1994). On the basis of the Track 2 risk evaluation, a non-time critical removal action under OU 10-06 was performed in 1995 in the soil area. A total of 2,092 m^3 (2,737 yd^3) of soil was removed from the roughly triangular area, which is 180 m (600 ft) by 90 m (300 ft) area. The average soil removal depth was 19 cm (7.5 in). with a maximum of 45.7 cm (18 in.) of soil removed in the deepest excavation. Following the OU 10-06 removal action verification, soil samples were collected from the surface within the excavated area and analyzed for gamma-emitting radionuclides. The activities of Cs-137 in the 27 samples were all below the PRG of 16.7 pCi/g (LMITCO 1996).

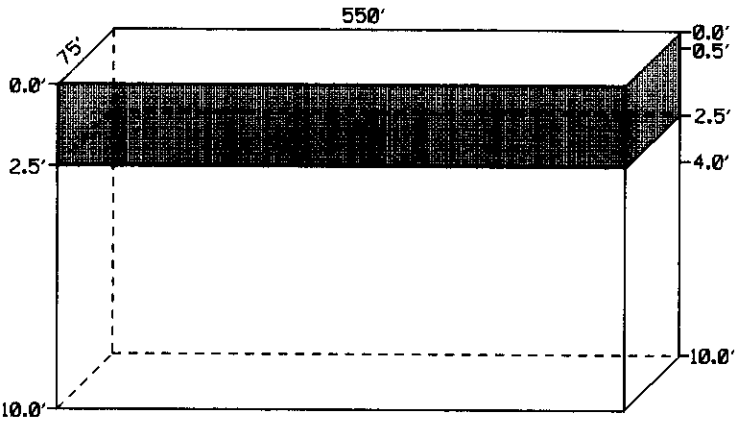
4.1.5.11.3 Nature and Extent of Contamination—Based on the sampling results, an area of contamination were identified (using a portable NaI scintillometer) within Area B with gamma-radiation readings greater than 15 pCi/g (field screening action level) that were not removed during the OU 10-06 removal action. The area is located within a 15.2 by 152.4 m (50 by 500 ft) long strip adjacent to Snake Avenue in the eastern portion of the site (LMITCO 1996). A portion of this strip was scheduled for remediation during the 1996 OU 10-06 removal action; however because contamination is suspected of extending below the roadway and thus the area was not excavated. The residual nature and extent of contamination remaining at the site and risks presented by that contamination are evaluated under this RI/BRA. The assumptions of the nature and extent of contamination as well as the source-term estimates for TSF-06 Area B are shown on Figure 4-22. The concentrations for this unremediated area were assumed from the results of the Track 2.

The COPCs for Area B, based on the contaminant screening process detailed in Section 6 and Table B-13, are shown in Table 4-12.

4.1.6 OU 1-05: TSF-09, the TSF Intermediate-Level (Radioactive) Waste Disposal, and TSF-18, the TSF Contaminated Tank Southeast of Tank V-3

4.1.6.1 Site Summary. The TSF Intermediate-Level (Radioactive) Waste Disposal Site (TSF-09) and the TSF Contaminated Tank southeast of Tank V-3 (TSF-18) are situated in the same area at TAN and, therefore, have been included together in this section. The TSF-09 and TSF-18 sites are situated in an open area east of TAN-616 and north of TAN-607, as shown on Figure 4-23. TSF-09 consists of three abandoned USTs that were once part of the TSF intermediate-level radioactive waste disposal system. TSF-18, also part of the intermediate-level waste disposal system, consists of an abandoned 1,514 L (400-gal) UST and sand filter located approximately 2.4 m (8 ft) southeast of TSF-09. The tanks at TSF-09 and TSF-18 were installed in the early 1950s as part of the system designed to collect for treatment (1) radioactive liquid effluents generated in the hot cells, laboratories, decontamination facilities at TAN and (2) waste from the IET facility. Based on process knowledge and site use, the known or suspected types of contamination at the sites include metals (barium, cadmium, chromium, lead, mercury, and silver), VOCs (trichloroethene, 1,1,1-trichloroethane, carbon tetrachloride, and acetone), SVOCs (PCBs and Stoddard solvent), and radionuclides (Cs-137, Co-60, Sr-90, and various isotopes of plutonium and uranium).





Exposure Point Concentration (2) (pCi/g)			
Receptor/Pathway	Depth	Cs-137	Co-60
Occ (3) - Air	0-0.5'	150	0.185
Occ (3) - External Rad.	0-4'	112.5	0.1388
Res (4) - All	0-10'	45	0.0555
Res (4) - Groundwater	0>10'	45	0.0555

LEGEND

Zone of contamination for Cs-137 and Co-60.

ASSUMPTIONS:

- The zone is conservatively assumed to extend .76 m (2.5 ft) bgs and extends below Snake Ave.
- The area of contamination is assumed to be the area of the site.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-22. TSF-06, Area B, nature and extent assumptions.

Table 4-12. Summary statistics for TSF-06 Area B.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.175 +/– 0.03	0.185 +/– 0.03	1.80E–01	7.07E–03	2	2	100%	—	NA
Cs-137	48.8 +/– 3.49	150 +/– 10.6	1.10E+02	5.38+01	3	3	100%	1.28	3

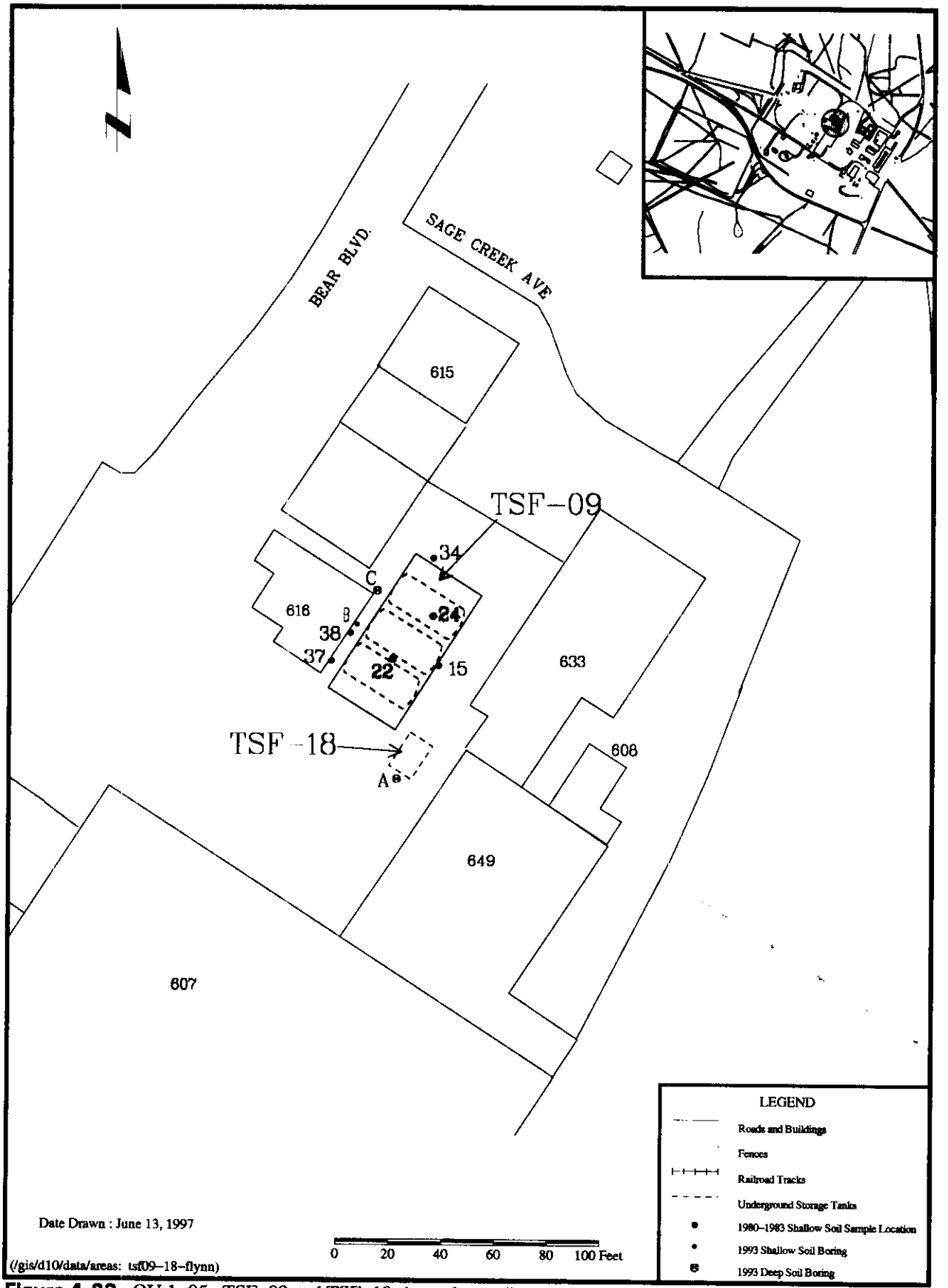


Figure 4-23. OU 1–05: TSF–09 and TSF–18 site and sampling map.

The tank at TSF-18, referred to as V-9, is a 1,514 L (400-gal) stainless steel sump tank located approximately 2.1 m (7 ft) bgs. It is accessible by a 15.2 cm (6-in.) diameter vent pipe that extends to the ground surface. The conical tank is 0.9 m (3 ft) in diameter in the center and extends approximately 2.1 m (7 ft) down to the tip of the cone. On the basis of information obtained during the RI, the tank contains approximately 0.9 m (3 ft) of sludge, 0.9 m (3 ft) of liquid and 0.3 m (1 ft) of headspace. Radiation readings in the tank range from 9 mrem/h on contact just inside the 15.2 cm (6-in.) riser to 10,500 mrem/h just inside the tank. The historical uses of the tank are not well documented. Although the tank was installed in the early 1950s and was indicated as a sump tank in facility "as-built" drawings, facility personnel are not aware of what the tank was used for in the past. Reportedly, the tank was modified in the early 1970s to serve as a sand filter, but the tank was used for only one day before being abandoned because of clogging. The nature of the reported modifications are unknown, because the visual evidence collected during the RI are consistent with the tank configuration shown in earlier "as-built" drawings. It was recently determined that a concrete structure located above the ground surface and near the TSF-18 tank contains sand. This structure is believed to be the sandfilter installed in the 1970s.

The results of the sampling and analysis of the tank contents performed during the RI indicate that chemicals in the tank are very similar to those found in the tanks at Site TSF-09. High concentrations of Sr-90, Cs-137, Co-60, and trichloroethylene were detected during the analysis. These are consistent with contaminants found in the TSF-09 tanks during the Track 2 investigation in 1993. The internal visual evidence obtained during the RI with a remote camera indicates that the tank is in good condition.

The history and uses of the TSF-09 tanks, referred to as V-1, V-2, and V-3, are much more well understood. The three 37,850-L (10,000-gal) tanks have been used since they were installed to store radioactive liquid wastes generated at TAN. The waste collected in the tanks was treated in the evaporator system located in TAN-616. Treatment residues were sent to the TSF injection well or the PM-2A tanks at TSF-26. After the evaporator system in TAN-616 failed in 1970, waste stored in the TSF-09 tanks was sent directly to the PM-2A tanks. After 1975, waste that accumulated in the tanks was pumped out and shipped to the Idaho Chemical Processing Plant (ICPP) via tanker truck. Surface soils surrounding the tanks reportedly became contaminated because of spills during operation of the tanks and from runoff from an adjacent cask storage pad (LMITCO 1994). In approximately 1968, a large quantity of oil was discovered in Tank V-2, and it was taken out of service. The oil was removed from the tank in 1981, and the water in the three tanks was removed in 1982. During removal of the water approximately 6,434.5 L (1,700 gal) of water were accidentally allowed to drain onto the ground. The liquid puddled in a soil depression along the west side of the tank manways and flowed north out of the radiologically controlled area through a shallow ditch. During cleanup operations, approximately 3.8 m^3 (128 ft^3) of radioactive soil in a 0.9 m^2 (10 ft^2) area north of the tanks and outside the post radiological control zone was removed. The excavation was backfilled with clean soil (EG&G 1982). There are no indications that clean soil was placed in the area around the tanks following the spill. The tanks have not been used since the 1980s, although liquids may have accidentally discharged to the tanks during the 1980s.

The stainless steel tanks are 3 m (10 ft) in diameter and 5.5 m (18 ft) long. They are buried approximately 3 m (10 ft) belowgrade. The tanks have 50.8 cm (20 in.) manholes that are accessible through 1.8-m (6-ft) diameter culverts installed in 1981. Valve indicators that control flow to and from the three tanks have recently been verified as closed, although the valves themselves have not been physically checked because of high radiation fields in the building where the valves are located, TAN-616. A gasket was installed in the manhole on Tank V-3 in March 1996 to prevent the infiltration of snowmelt and rainwater into the tank through the manhole. The problem was suspected because of rising liquid levels measured in the tank and the location of the tank in a topographical low. No significant level changes have

been observed since the gasket has been installed. Although the liquid level has stabilized, the tank has not undergone a spring thaw.

4.1.6.2 Previous Investigations. Prior to the 6,435 L (1,700-gal) spill of liquid from Tank V-2 in the early 1980s, the shallow soils surrounding the tanks were characterized for radiological contamination. An area approximately 24.4 by 15.2 m (80 by 50 ft) area was divided into 3-m (10-ft) grids and a surface beta/gamma radiation survey was performed. Composite samples were collected from sampling trenches 1.5 m (5 ft) long, 0.9 m (3 ft) wide dug in six of the survey grids. The sample locations (Figure 4-23) were biased toward grids in which either very high levels of radioactivity were detected during field screening (grids No. 22, No. 38, and No. 37) or in which very low levels of radioactivity were detected (grids No. 15, No. 24, and No. 34). The composites, formed from subsamples collected from the sides and bottom of the sampling trench were collected in 15.2-cm (6-in). increments to 91.4 cm (36 in.) bgs. The collected samples were submitted to Radiological Measurement Laboratory (RML) for gamma spectroscopy analysis. High concentrations of Cs-137 and Co-60 were detected in all of the surface samples and in all cases, the concentrations at 91.4 cm (36 in.) were elevated above background activities (EG&G 1983a). In 1988, three soil borings were drilled in the TSF-09/-18 area. Soil samples were collected from 0.3 to 0.6 m (1 to 2 ft) and submitted to an analytical laboratory for inorganic analysis. Beryllium, arsenic, mercury, and sodium concentrations were not substantially elevated over expected background concentrations (LMITCO 1994).

During the 1993 Track 2 investigation, three borings were drilled in the TSF-09/-18 area. One boring was located just south of the valve pit next to TSF-18, a second boring was located just off the southwest corner of Tank V-2, and the third boring was placed in the drainage ditch north of Tank V-3. At all three of the sample locations, gross beta activities in the surface soils 0 to 19.2 cm (0 to 6 in.) were elevated over what would be expected from background concentrations from natural radioactivity in surface soils at the INEEL. Based on the results of the 1993 TSF-09 and 1996 TSF-18 tank sampling, it is very probable that the elevated gross beta activities are a result of Sr-90 contamination in the soil, which would imply the presence of Cs-137 in the soil as well. Gross alpha activities did not appear elevated and the activities of gamma-emitting radionuclides in the samples were not measured. Between the surface and 0.8 m (2.5 ft) in the first boring, low activities of Cs-137 and Co-60 were detected and gross beta concentrations were elevated. Between 6.1 and 6.7 m (20 and 22 ft) bgs in the first boring, no gamma-emitting radionuclides were detected and gross alpha and beta activities appeared consistent with background concentrations. Borehole B located west of Tank V-2, was drilled to a total depth of 2.1 m (7 ft). The gross beta concentrations in the same collected between 1.8 and 2.1 m (6 and 7 ft) was elevated over background values. Cs-137 and Co-60 were detected in the sample at 103 ± 7.4 pCi/g and 0.13 ± 0.02 pCi/g, respectively. In Borehole C, located in the TSF-09 drainage ditch, grab samples were collected from the 0.1-to-0.8-m (0.5-to-2.5-ft) interval, and 5.5-to-6.7-m (18-to-20-ft) interval. Radionuclide concentrations in the 0.1-to-0.8-m (0.5-to-2.5-ft) interval did not appear contaminated, but elevated gross beta and Cs-137 activities were detected in the 5.5-to-6.7-m (18-to-20-ft) interval. The results of the inorganic analysis of samples from various intervals in the boreholes did not indicate elevated concentrations of metals at any of the locations or depths. Samples from shallow and deep subsurface intervals were analyzed for TCL SVOCs from all three boreholes, and none were detected in any of the samples. Acetone (LMITCO 1994), trichloroethylene, and Aroclor-1254 were detected at very low concentrations, in the samples from the three boreholes. These are significant, however, because these are contaminants associated with the tanks. Trichloroethylene was detected in extremely high concentrations in the tanks in the 1993 Track 2 sampling and was known to have been used extensively in decontamination operations at TAN in the past. The oil removed from Tank V-2 in 1981 is known to contain high concentrations of PCBs. Acetone, however, was not detected in the 1993 sampling of the TSF-09 tanks or the 1996 analysis of the TSF-18 tank samples.

4.1.6.3 Nature and Extent of Contamination. Because the tanks and controls are still in place, the nature and extent of contamination at TSF-09/-18 has not been completely defined, however the data do provide enough information to make a conservative estimate of site risk. On the basis of the past sampling and the current radiation surveys in the area, the TSF-09/-18 site is assumed to include the area currently enclosed by a soil contamination fence. The soil contamination area is a roughly rectangular area 19.2 m (50 ft) wide by 24.4 m (80 ft) long. The soil and basalt interface at the site is estimated to be between 11.6 and 17.4 m (38 and 57 ft) bgs based on historical well and boring data. The deepest samples collected at the site were from 6.7 to 7.3 m (22 to 24 ft) bgs. The depth of radionuclide contamination at the site is known to extend to 14.5 m (20 ft) in at least one location (Boring C). The depth of the contaminated zone at the site for all the COPCs is conservatively estimated to be 14.5 m (47.5 ft), the estimated midpoint to basalt (LMITCO 1994). This is a conservative estimate because there are no sample results indicating contamination to 14.5 m (47.5 ft) bgs. Figure 4-24 shows the assumptions for the nature and extent of contamination as well as the source-term estimates.

The COPCs at TSF-09 and TSF-18, based on the contaminant screening process detailed in Section 6 and Table B-16, are shown in Table 4-13.

4.1.7 OU 1-05: TSF-10, Drainage Pond

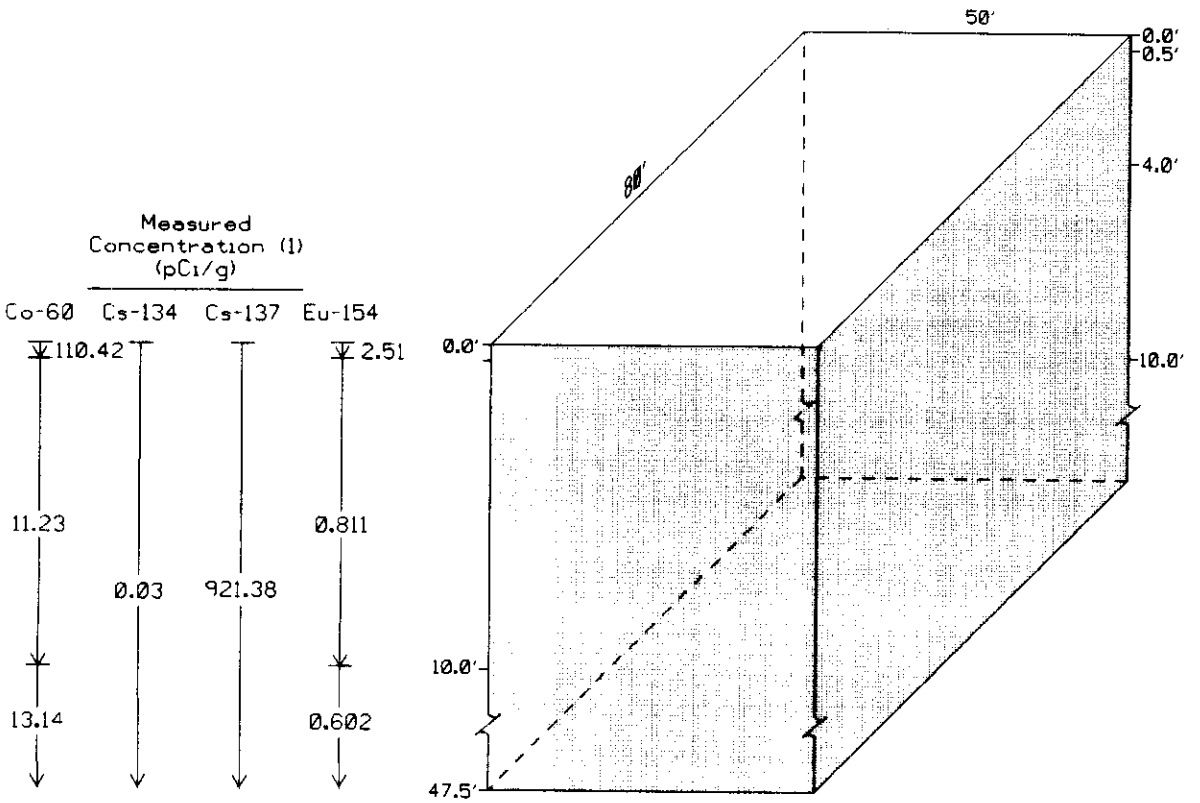
4.1.7.1 Site Summary. TSF-10 is a drainage pond located at the western end of TSF, shown on Figure 4-25. The pond was originally designed as an infiltration pond. Historical information indicates that the pond was usually dry and, at present, no operations or processes discharge to the pond. The pond does receive intermittent surface-water runoff and occasional discharge of monitoring well purge water.

The TSF-10 pond was built prior to 1958. When constructed, the pond was 36.6 by 71.6 by 2.1 m (120 by 235 by 7 ft) with an approximate capacity of 5,700 m^3 (1.5E06 gal). The surface area of the pond was increased in 1967; however, the volume was actually reduced with the installation of a corrugated metal pipe overflow drain. The overflow drain decreased the depth 0.7 m (2.3 ft) with a corresponding reduction in capacity to approximately 5,300 m^3 (1.4E06 gal), although personnel reports this overflow drain has never been utilized. Other modifications to TSF-10 (also completed in 1967) included the installation of a 0.3 m (1 ft) corrugated metal pipe from the TSF-29 acid pond and a 0.3-m (1-ft) drain along the west side of TAN-607. Both discharge to TSF-10. According to personnel, there has never been enough water to create overflow from TSF-29 to TSF-10.

Other sources of discharge to TSF-10 include storm drains along the east and south sides of TAN-607 and drains adjacent to buildings TAN-636 and TAN-660. Ditches around areas, TAN-609 and the TSF-26 site, also drain to TSF-10 through a culvert located on the east side of the pond. The southeast corner of TSF-10 also has received effluent from the Sewage Plant Lift Station (TAN-655) when the lift station backed up or was not operating. Process knowledge and sampling data about the sites that drain to the pond indicate that radionuclides, metals, and possibly VOCs and SVOCs may have been discharged to the pond.

4.1.7.1.1 Previous Investigations. A Department of Energy (DOE) soil sampling program was conducted at TSF-10 in 1988. During this program, four soil samples were collected at discrete intervals from each of three different boring locations within the TSF-10 pond (see Figure 4-25). The soil samples were collected from the east-central portion of the pond, the southwest corner of the pond, and the south-central portion of the pond. Concentrations of metals and Cs-137 were greater than background values; however, no VOCs, SVOCs, or alpha/beta-emitting radionuclides were detected.

TSF-09/18



Exposure Point Concentration (2) (mg/Kg or pCi/g)					
Receptor/Pathway	Depth	Cs-137	Cs-137	Cs-137	Cs-137
Occ (3) - Air	0-0.5'	110.42	0.03	921.38	2.51
Occ (3) - External Rad.	0-4'	36.03	0.03	921.38	1.24
Res (4) - All	0-10'	21.15	0.03	921.38	0.981
Res (4) - Groundwater	0>10'	15.15	0.03	941.24	0.865

LEGEND

Zone of contamination for Co-60, Cs-134, Cs-137, and Eu-154.

ASSUMPTIONS:

- Volume of soil excludes tank volume for > 3.05 m (10 ft).
- The zone of contamination is assumed from surface to 14.48 m (47.5 ft) bgs because of known surface releases and contamination detected at depth. 14.48 m (47.5 ft) represents midpoint to basalt.
- The area of contamination encompasses the site area for both TSF-09 and TSF-18.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.
(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.
(3) Occupational Scenario.
(4) Residential Scenario.

Figure 4-24. OU 1-05: TSF-09 and TSF-18, nature and extent assumptions.

Table 4-13. Summary statistics for TSF-09/-18.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.04 +/- 0.07	110.42 +/- 4	1.01E+01	2.56E+01	45	45	100%	—	NA
Cs-134	10.01 +/- 0.02	0.2 +/- 6	8.33E-03	3.43E-02	42	42	100%	—	NA
Cs-137	0.0618	40148.94 +/- 60	1.69E+03	7.65E+03	46	46	100%	1.28	32
Eu-154	0.47	2.51 +/- 1	7.10E-02	3.92E-01	42	42	100%	—	NA

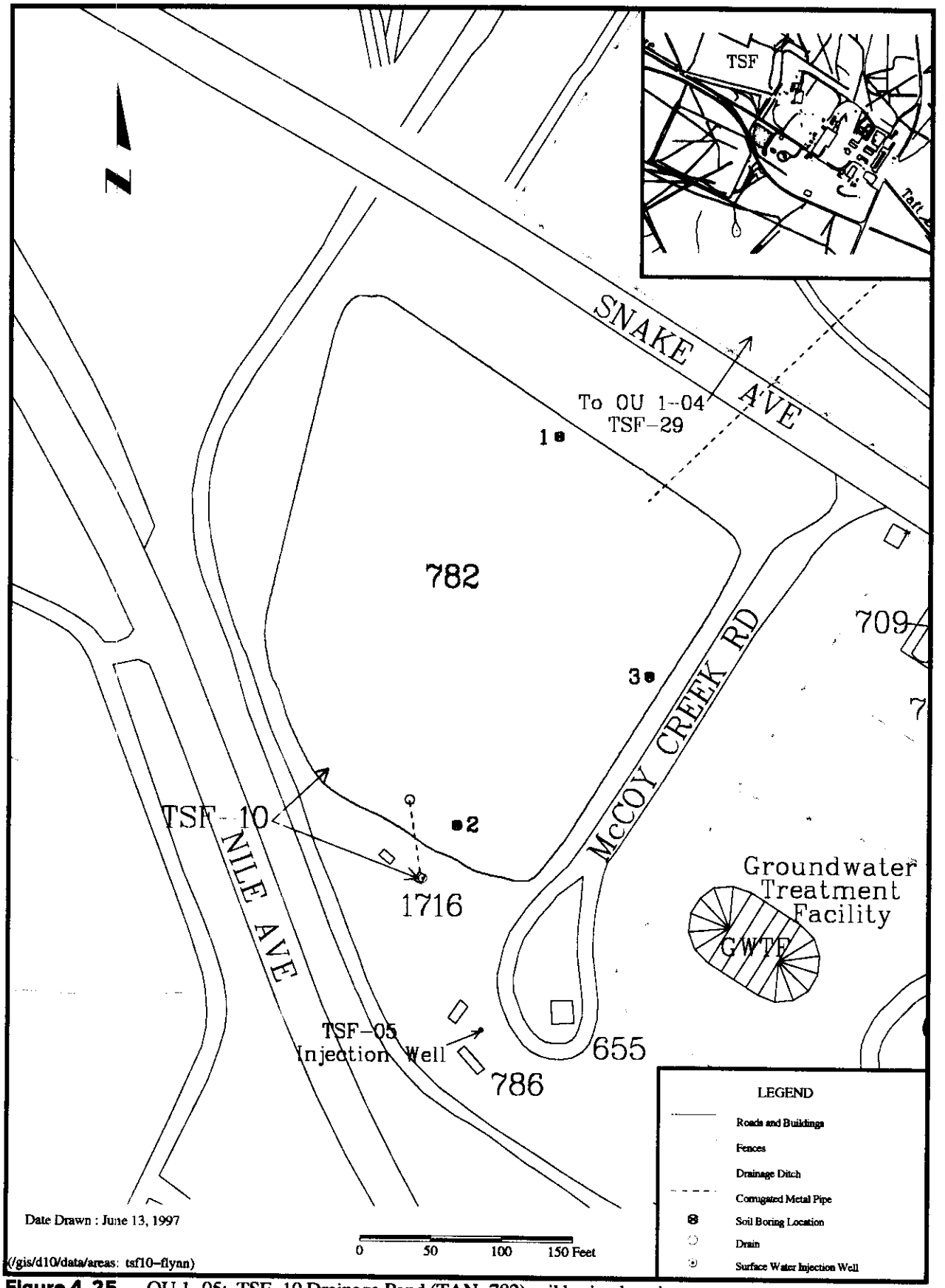


Figure 4-25. OU 1-05: TSF-10 Drainage Pond (TAN-782) soil boring locations.

A phased Track 2 investigation was designed for the TSF-10 site. During Phase I of this investigation, additional site historical data (photographs, site reports, etc.) were collected and reviewed and a radiation field survey was conducted. This information was combined with results from the 1988 DOE sampling program. Based on results of the Phase I activities, it was determined that no Phase II sampling of TSF-10 pond sediments was required.

4.1.7.2 Nature and Extent of Contamination. Based on the sampling results, the areal extent of contamination is conservatively assumed as the site area 2,601 m^2 (28,500 ft^2). Elevated Cs-137 concentrations are assumed to be confined to the top 0.6 m (2 ft) as substantiated by the sampling results (i.e., Cs-137 concentrations fall below the background of 1.28 pCi/g for all other depths sampled). Manganese, although present only at levels slightly in excess of background values (i.e., 700 mg/kg), is conservatively assumed to contaminate a zone from 0.6 to 5.5 m (2 to 18 ft) bgs. Cs-137 was detected at a maximum concentration of 6.3 pCi/g in the sample collected in east-central portion of the pond from the 0-to-0.6-m (0-to-2-ft) interval. Manganese was detected at the same sample location at a maximum concentration of 953 mg/kg from the 3-to-3.6-m (10-to-12-ft) interval. Figure 4-26 shows the assumptions for the nature and extent of contamination as well as source-term estimates for TSF-10.

The COPCs at TSF-10, based on the contaminant screening process detailed in Section 6 and Table B-17, are shown in Table 4-14.

4.1.8 OU 1-05: TSF-21, Initial Engine Test Valve Pit

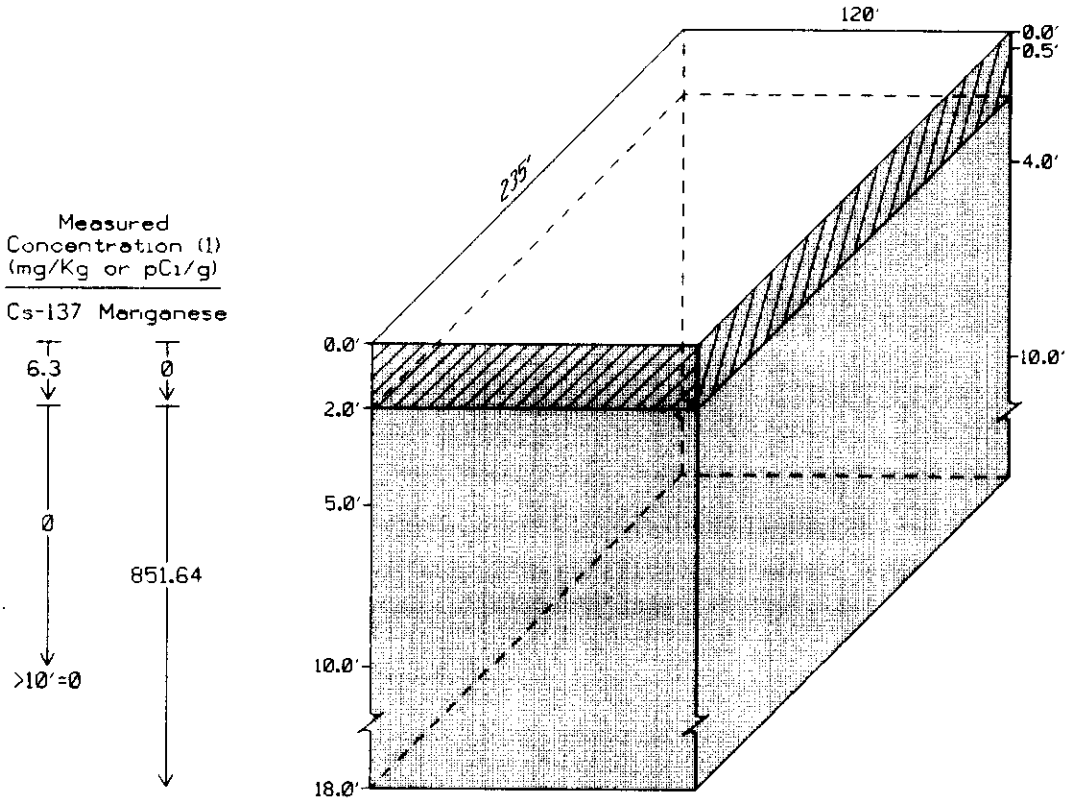
4.1.8.1 Site Summary. The TSF IET valve pit (TSF-21) consisted of an at-grade concrete vault containing valves that controlled the flow of wastewater from the IET facility and portions of TAN-607 to the intermediate-level (radioactive) waste treatment system (the TAN-616 Evaporation Building and TSF-09 V-tanks). The TSF-21 site is located in an open area approximately 18.3 m (60 ft) north of TSF-09, as shown in Figure 4-27. The deep valve pit was approximately 1.8 by 2.2 by 2.2 m (6 by 7 by 7 ft), and had a mud sump extension 0.3 by 0.3 by 0.3 m (1 by 1 by 1 ft) at the base. The valve pit was constructed in the 1950s and was modified several times between the 1950s and the 1970s, during redesign of the radioactive waste treatment system in TAN-616. Use of the valve pit was discontinued in the 1970s.

In 1987, the 5-cm (2-in.) drain line from the IET facility to the valve pit was removed. During the removal process, excess wastewater from the pipe accidentally drained into the valve pit and overflowed onto the surrounding ground. The spill was contained immediately, and the contaminated soil was removed and replaced with clean soil fill or covered in place. At the same time, the remaining piping systems were blind-flanged off within the pit. The soil fill extended to approximately 1.5 m (5 ft) bgs.

The valve pit contents, sludge, and debris were removed in September 1993. The valve pit contents exhibited a strong petroleum odor, and monitoring indicated that organic vapors in the breathing zone were 100 ppm. Approximately 45.43 m^2 (1,622.5 ft^3) of surrounding soil was excavated and the associated piping was removed.

4.1.8.2 Previous Investigations. In July 1993, vault liquids and sludge were sampled to further characterize the contents. Liquid samples were collected at two locations within TSF-21, and a sludge sample was collected at one location.

The results of the analysis indicated the tank contents contained elevated levels of radionuclides (i.e., Am-241, Pu-238, Pu-239, uranium isotopes, Sr-90, H-3, Cs-134, Cs-137, and Co-60) and VOCs (i.e., methylene chloride, 1,1-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethene, 1,1,1-trichloroethane,



Exposure Point Concentration (2) (mg/Kg or pCi/g)			
Receptor/Pathway	Depth	Cs-137	Manganese
Occ (3) - Air	0-0.5'	6.3	0
Occ (3) - External Rad.	0-4'	3.15	425.82
Res (4) - All	0-10'	1.26	681.312
Res (4) - Groundwater	0>10'	0.7	425.82

LEGEND

Zone of contamination for Cs-137.

Zone of contamination for Manganese.

ASSUMPTIONS:

- The area of contamination is consrvatively assumed as the site area.
- The zone of contamination for Cs-137 is limited to the top .61 m (2 ft) because Cs-137 concentrations drop below background below this interval.
- The zone of contamination for Mn is from .61 m (2 ft) to 5.49 m (18 ft) bgs because of slightly elevated concentrations throughtout the interval.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-26. OU 1-05: TSF-10, Drainage Pond (TAN-782), nature and extent assumptions.

Table 4-14. Summary statistics TSF-10.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Manganese	518	953	7.22E+02	1.22E+02	8	8	100%	700	5
Cs-137	0.07	6.3	8.96E-01	2.18E+00	8	8	100%	1.28	1

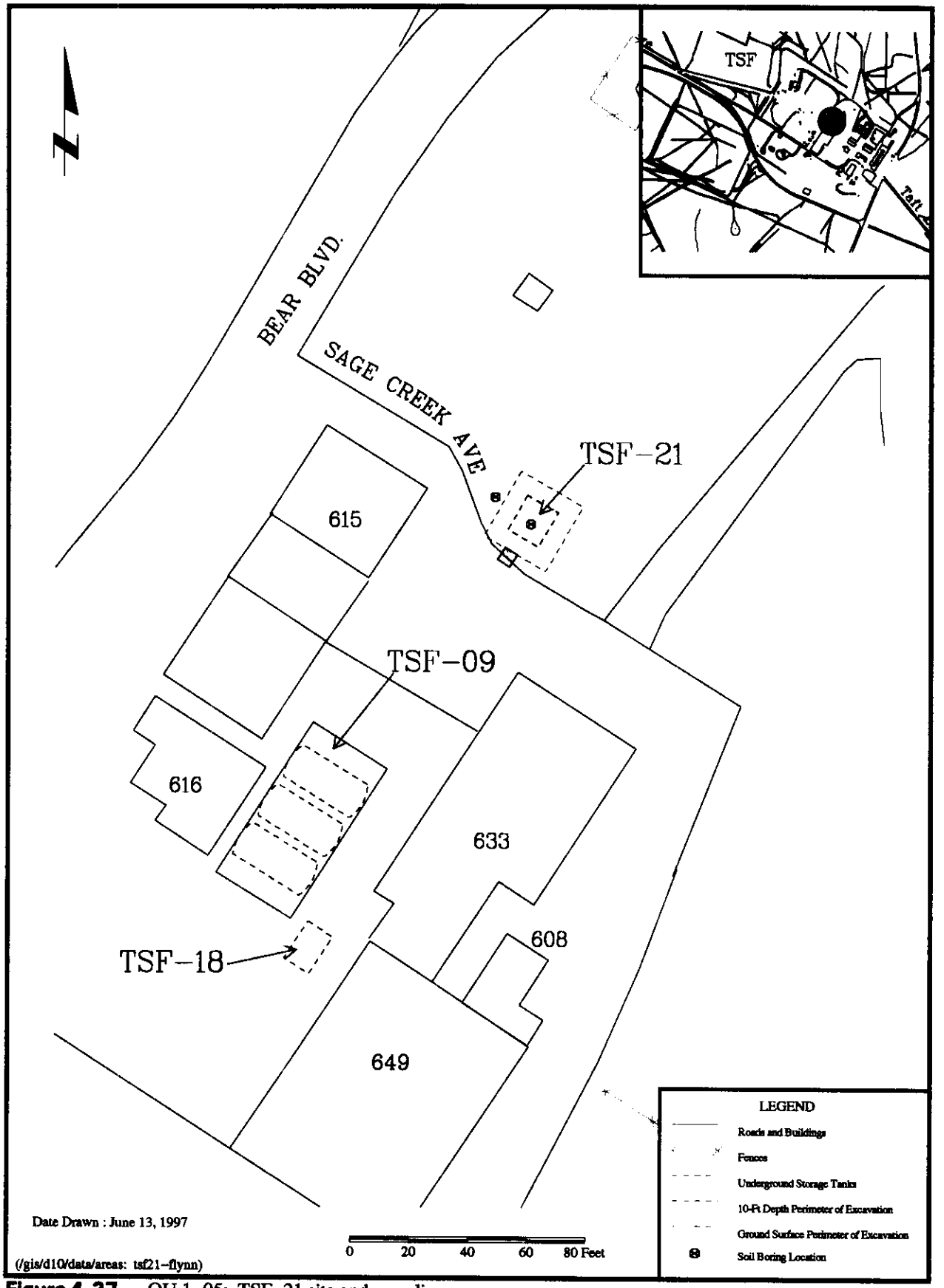


Figure 4-27. OU 1–05: TSF–21 site and sampling map.

trichloroethene, tetrachloroethene, ethylbenzene, and xylene). Analysis of the metals, SVOCs, and pesticides in the contents sample did not yield elevated results. One PCB, Aroclor-1260, was also detected in the liquid and sludge.

During TSF-21 valve pit removal activities in October 1993, VOC and radiation field screening was conducted of the valve pit excavation and excavated soil. During excavation, each bucket of soil was monitored for beta/gamma- and alpha-emitting radionuclides and was segregated based on radiological content. The fill measured less than 100 cpm beta/gamma activity.

Soil immediately surrounding the valve pit, at a depth of 1.5 m (5 ft), indicated that higher levels of contamination were present and in greater amounts than previously anticipated. This zone of contamination corresponded with a change in soil type from a well-graded sandy material to a wet, hard clay. The well-graded sandy material was interpreted as being backfill material from the earlier 1987 cleanup of an overflow at the TSF-21 valve pit. As a result of finding contamination in amounts greater than anticipated, the excavation remained open for several days, while additional planning for the removal and disposal of the valve pit was completed.

On October 28, 1993, the soil verification samples were collected using a backhoe bucket to reach into the excavation and remove 5 to 10 cm (2 to 4 in.) of soil from the bottom of the excavation (Figure 4-27). The soil was collected from a depth of 3.4 m (11 ft) bgs and appeared to be clay. The samples were held at TAN for more than 20 days to comply with facility radiation screening and material release requirements. As a result, the holding times of the VOCs were exceeded by 18 days, but the holding time from extraction to analysis was not exceeded for the SVOC extracts.

Three verification soil samples were collected from the soil directly beneath the valve pit and along the north-south axis of the pit. Sample 1, TA11401, was collected from beneath the south end of the valve pit, 1TA11201 was collected from beneath the middle of the valve pit; and 1TA11301 was collected from beneath the north end of the valve pit. The samples were analyzed for metals, VOCs, SVOCs, gross alpha/beta activity, and gamma spectroscopy. With the exception of PCB, this analyte suite encompassed the suspected contaminants for the site.

Gross alpha/beta analysis results did not warrant isotope-specific analysis (i.e., field measurements indicate they were less than background). As indicated in Table 4-15, Cs-137 and Co-60 were the only gamma-emitting radionuclides detected at average activities of 0.99 and 317 pCi/g, respectively. The VOC and SVOC analyses were detected at ppb levels of contamination; however, holding time problems are noted with the samples. Metals analysis results were within background concentration ranges. Diethylphthalate was the only SVOC detected and the concentration was low (44 μg/kg).

In late December 1993, two soil borings were completed to determine the extent and concentration of the potential soil contamination. The first boring was completed at approximately the center of the former TSF-21 site. The boring initially went through backfill material to a depth of 3.4 m (11 ft) and then encountered a hard, compact clay. No contamination was detected in field screening to depth of 3.4 m (11 ft). However, field screening did detect elevated concentrations of radiation (10 to 30 mrem/h) and VOCs (>100 ppm) from 3.4 to 5.5 m (11 to 18 ft) deep. A soil change from hard clay to sand was observed at approximately 5.2 to 5.5 m (17 to 18 ft). The boring was completed to 5.5 m (18 ft). A soil sample from 4.9 to 5.5 m (16 to 18 ft) was collected for gamma spectroscopy, metals, and VOC analyses. Gamma spectroscopy results indicated Cs-137 was elevated above background at 20.57 pCi/g and Co-60 was measured at 0.12 pCi/g. Methylene chloride, acetone, and trichloroethene were also detected at 4, 4, and 16 mg/kg, respectively. Metals were not detected above background concentrations.

Table 4-15. Summary statistics for TSF-21.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.108 +/– 0.02	1.73 +/– 0.14	8.82E–01	8.79E–01	4	4	100%	—	NA
Cs-137	13 +/– 0.93	821 +/– 59.4	2.79E+02	3.79E+02	4	4	100%	1.28	4

The second boring was completed to a depth of 5.8 m (19 ft) and was located 4.6 m (15 ft) down-slope and to the west of the former TSF-21 site. No radiation or VOCs were detected above background or field screening limits, respectively, in this boring. A sample was collected from the 5.2-to-5.8-m (17-to-19-ft) interval and analyzed for gamma spectroscopy, metals, and VOCs. Elevated levels of Cs-137 (18.9 ± 1.6 pCi/g) were detected in the sample from the first boring. Co-60 was also detected at 0.108 ± 0.19 pCi/g. Metals concentrations were, for the most part, within expected background ranges. Trichloroethane and methylene chloride were detected in both boreholes at average concentrations of 18 and 3.5 µg/kg, respectively. Acetone was detected in the first borehole at a concentration of 4 µg/kg.

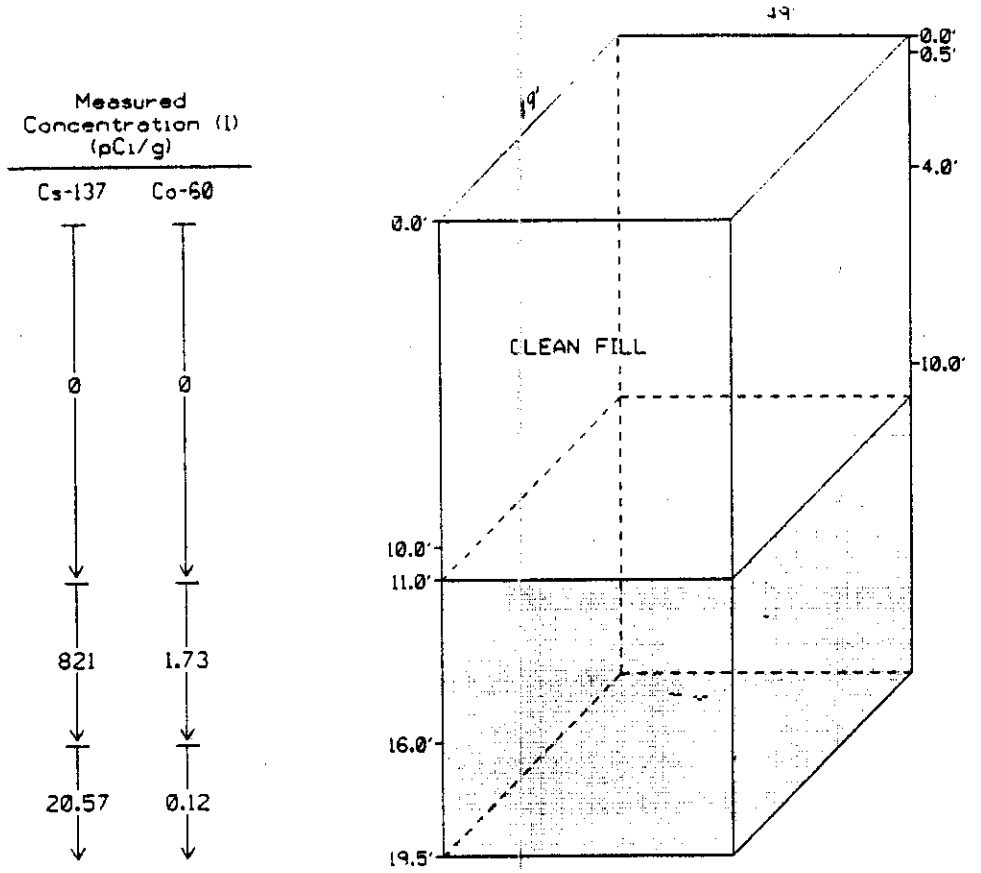
4.1.8.3 Nature and Extent of Contamination. Based on the sampling results, the contaminated area is estimated to be 14.9 m^2 (49 ft^2), the area of the valve pit that defines TSF-21. The vertical extent of contamination is assumed to be from 3.4 m (11 ft) to the bottom of the clay layer at 6 m (19.5 ft) bgs. The site was excavated to a depth of 3.4 m (11 ft) and backfilled with clean soil. The clay layer encountered from 3.4 to 5.2 m (11 to 17 ft) bgs is assumed to act as an attenuating layer as demonstrated by a decrease in Cs-137 from 821 to 18 pCi/g in this interval. Figure 4-28 shows the assumption for the nature and extent of contamination as well as source-term estimates for TSF-21.

The COPCs at TSF-21, based on the contaminant screening process detailed in Section 6 and Table B-19, are shown in Table 4-15.

4.1.9 OU 1-05: TSF-26 and TSF PM-2A Tanks

4.1.9.1 Site Summary. The PM-2A tanks (variously referred to as the PM-2A tanks, TAN-709 and TAN-710, or V-13 and V-14) have been used from when they were installed, in approximately 1955, until 1972 to store concentrated low-level radioactive wastes from the TAN-616 evaporator. In 1972, an evaporator system (the PM-2A system) was installed in the TSF-26 area to replace the failing system in TAN-616. The PM-2A facility at TSF-26 included the aboveground evaporator system, the underground holding tanks and feedlines (V-13 and V-14), an electrical distribution subsystem, and one concrete tank located aboveground about 30 m (98.4 ft) southwest of the evaporator system. Figure 4-29 shows the location of the PM-2A tanks. Waste was pumped directly from Tanks V-1, V-2, and V-3 (TSF-09) to the tanks at TSF-26. The tanks served as feed tanks for the new evaporator system in which the liquid waste was evaporated, condensed, passed through an ion-exchange column, and discharged as clean water into the disposal pond (TSF-07). There is only one anecdotal report of a large spill of radioactive liquid (in 1972) at the site during operations (LMITCO 1994). Because of operational difficulties and spillage, the system was shut down in 1975. Most of the liquids in the PM-2A tanks were pumped out into concrete containers, mixed with cement and shipped to the RWMC for burial. During the removal operation, an approximately 3,000-m^2 (33,333 ft^2) area east of the tanks was contaminated by (1) spills and leakage during the pumping, (2) spills of the mixed cement product, and (3) paint running off the leaking contaminated concrete containers (EG&G 1980). Based on process knowledge and site use, the known or suspected types of contamination at the PM-2A site include metals (barium, cadmium, chromium, lead, mercury, and silver), VOCs (trichloroethene, 1,1,1-trichloroethane, carbon tetrachloride, and acetone), SVOCs (Stoddard fluid), and radionuclides (Cs-137, Co-60, Sr-90, and various isotopes of plutonium and uranium).

During the 1981 and 1982 D&D of the PM-2A facility, all aboveground hardware from the PM-2A area was removed, packaged, and shipped to the RWMC for burial. The underground piping was deactivated and abandoned in place. The 10.2-cm (4-in.) piping to the tanks was cut and capped. The piping consisted of a 3.35-m (1,100-ft) run of two parallel, 10.2-cm (4-in.) (outside diameter) pipes from Building TAN-616 along the western edge of the roadway west of Building TAN-607 to the tanks. The



Exposure Point Concentration (2) (pCi/g)			
Receptor/Pathway	Depth	Cs-137	Co-60
Occ (3) - Air	0-0.5'	0	0
Occ (3) - External Rad.	0-4'	0	0
Res (4) - All	0-10'	0	0
Res (4) - Groundwater	>10'	172.1	0.3549

LEGEND

Zone of contamination for Cs-137 and Co-60.

ASSUMPTIONS:

- Site was backfilled with 3.35 m (11 ft) of clean soil.
- The zone of contamination is assumed to start at 3.35 m (11 ft) bgs (the base of the TSF-21 excavation), extend through the clay layer, and terminate .76 m (2.5 ft) below the clay layer at 5.94 m (19.5 ft) bgs.
- The area is assumed to encompass the previously excavated area out to the borehole location 4.57 m (15 ft) from the center of the excavated area.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-28. OU 1-05: TSF-21 nature and extent assumptions.

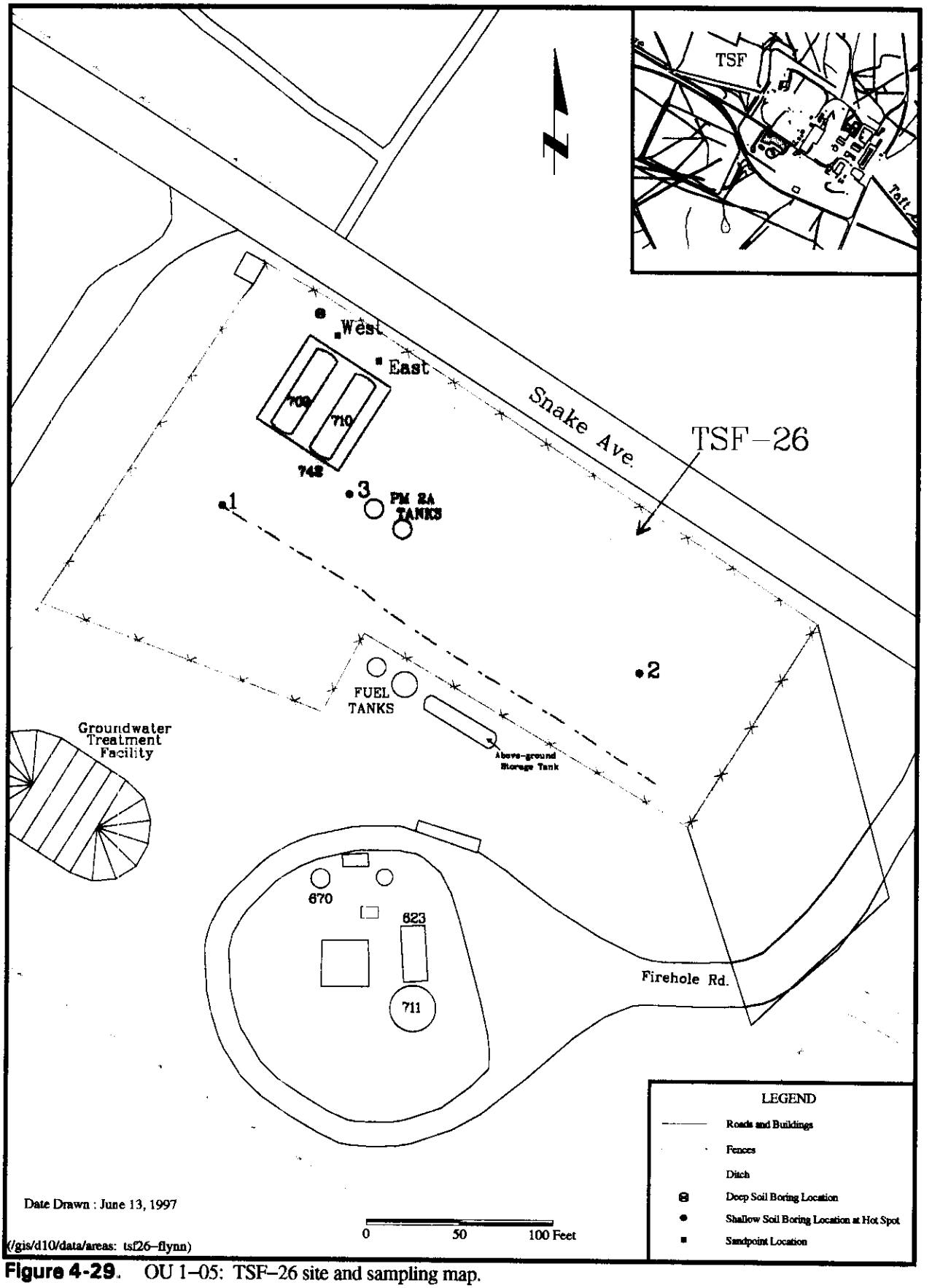


Figure 4-29. OU 1–05: TSF–26 site and sampling map.

piping at TAN-616 was buried approximately 1.5 m (5 ft) bgs and approximately 3 m (10 ft) from where it entered the tanks. During the cutting operations, sections of the piping were retained and analyzed. The beta/gamma fields inside the pipes were 100 mR/hr and 60 mrem/h. In the northern pipe section, 73% of the detected gamma activity was from Cs-137 and 27 % from Co-60. In the southern pipe section, 92% of the activity was from Cs-137, 8% was from Co-60, and less than 1% was from Eu-154. The Sr-90 activity, based on the determined ratio of Cs-137 to Sr-90 in TAN/TSF liquid waste, was estimated to be roughly equivalent to the Cs-137 activity (EG&G 1983b).

Liquids remaining in the PM-2A tanks were removed, solidified, and shipped to the RWMC for burial. Approximately 5,350 L (2,997 gal) of liquid was removed from the tanks. The slightly basic (pH of 9.11) liquid removed from V-13 contained approximately 1% total suspended solids and 0.59 mg/mL chloride. The liquid in Tank V-14 had a pH of 10.38, contained approximately 1% total suspended solids and 2.6 mg/mL chloride. Although the samples from both tanks were not quantified, the laboratory reported that they contained organic compounds (EG&G 1982). Project personnel also reported the visible presence of organics in the tank liquids (EG&G 1983b). Following removal of most of the liquids from the tanks, 0.6 cm (1/4-in.) of liquid and 30.5 cm (12-in.) of sludge [approximately 3,320 L (1,860 gal)] remained in Tank V-13. Tank V-14 reportedly contained 0.5 cm (1/5 in.) of liquid and 10.2 cm (4 in.) of sludge [approximately 1,637 L (360 gal)]. The liquids and sludges in the tanks were dried by depositing approximately 4,535,920 g (10,000 lbs) of diatomaceous earth over the sludge surface in each tank. The sludge in Tanks V-13 and V-14, sampled and analyzed in 1981 (prior to the addition of the diatomaceous earth), contained 45% and 26% total suspended solids, respectively. The estimated tank curie contents, based the 1981 gamma spectroscopy analysis and decay corrected to 1995, are 41.38 Ci and 25.96 Ci, (Cs-137, Co 60, Sr 90, Pu 239 and U 235/238)respectively for V-13 and V-14 (LMITCO 1996). The presence of the salts, radionuclides, and reported organics in the tank is consistent with the historical uses of the tanks.

The 15.2 cm (6 in.) of topsoil from a 22.9 by 45.7 m (75 by 150 ft) area roughly northeast of the tanks was removed, boxed, and shipped to RWMC for burial. The entire area was graded, backfilled with 15.2 to 25.4 cm (6 to 10 in.) of radiologically clean soil, and reseeded with crested wheat grass. The PM-2A area was fenced and the locations of the PM-2A tanks were marked with permanent brass markers.

Contaminated soils at the TSF-26 site are included in the OU 10-06 radionuclide-contaminated soils at the INEEL. A nontime critical removal action was initiated at the TSF-26 site in 1995 and will be completed in 1996. Figure 4-30 shows the approximate OU 10-06 pre-removal action contamination area within OU 1-05 TSF-26. More information on the contaminated soils at TSF-26 and the removal action activities can be found in the OU 10-06 RI/FS report (LMITCO 1996). In addition to the wooden box full of soil discovered at the TSF-26 site during the 1995 OU 10-06 removal action, other buried, unidentified waste may be present at the site.

4.1.9.2 Previous Investigations. In 1988 during a DOE environmental survey, four borings were drilled near the PM-2A tanks (see Figure 4-29). The results of the sampling and analysis indicated relatively low levels of Cs-137 contamination (i.e., 1.7 to 120 pCi/g) in the soil to at least 5.2 m (17 ft) bgs. Samples were not collected below 5.2 m (17 ft) (LMITCO 1994).

During the 1993 Track 2 investigation of TSF-26, a high resolution magnetic field survey and existing engineering drawings were used to determine the locations of the PM-2A tanks, associated piping, the sandpoints, and other buried metallic objects or waste at the site. To determine if contamination had migrated below the tanks, the two sandpoints, located north of the tanks within the concrete cradles, were excavated and reconstructed during the investigation. Water levels were measured in the sandpoints in the

Figure 4-30. Approximate OU 10–06 pre–removal action contamination areas within OU 1–05 TSF–26.

spring of 1993. The east sandpoint was 8.8 m (28.8 ft) deep and contained 0.2 m (0.65 ft) of water. The west sandpoint was 8 m (26.26 ft) deep and contained 2.8 m (9.2 ft) of water. The water in the west sandpoint was sampled for analysis of CLP VOCs, six CLP metals, gamma spectroscopy and gross alpha/beta. Insufficient water was present to collect a sample for CLP SVOC analysis. Two weeks after the completion of the sampling, the measured water level in the west sandpoint was 0.1 m (0.5 ft) (LMITCO 1994). Numerous VOCs and TICs were detected in the sandpoint at low concentrations. Chloroethane at 3,600 µg/L and benzene at 660 µg/L were the VOCs detected at the highest concentrations. The gross alpha and beta levels were 18 ± 4 pCi/L and 80 ± 5 pCi/L, respectively. In the gamma spectroscopy analysis, Cs-137 was detected at 26.1 ± 5.9 pCi/L.

One deep and three shallow borings were completed and sampled during the Track 2 investigation. Grab samples from the surface and at 1.5 m (5 ft) were collected from the three shallow borings. Radiological analysis was performed on the surface samples and analysis for organic contaminants (SVOCs, VOCs, and PCBs) was performed on the 1.5-m (5-ft) samples. The deep boring was drilled just off the northeast corner of the PM-2A tanks. A composite sample composed of cuttings from the surface to 9 m (30 ft) bgs was collected. The sample was submitted to an analytical laboratory for analysis of gross beta activity, gross alpha activity, gamma activities, six CLP metals, CLP VOCs, SVOCs, and PCBs. The results of the analysis indicate elevated gross beta and gamma activities in the at TSF-26. No VOCs, SVOCs, or PCBs were detected in any of the soil samples.

4.1.9.3 Nature and Extent of Contamination. Based on the sampling results, potentially contaminated site components at TSF-26 are as follows:

- Two abandoned 89,250-L (50,000-gal) carbon-steel USTs
- 50.32 m^3 (1,797 ft^3) sludge and diatomaceous earth in the abandoned USTs totaling approximately 2,250 gal of sludge and a minimal residual liquid totaling 100 gal.
- Cut, capped piping to and from the tanks in the area
- Concrete cradles and sand in which the USTs are contained
- Other subsurface features including two monitoring tubes and a 0.6 by 1.2 by 2.4 m (2 by 4 by 8 ft) wooden box of soil
- Contaminated soils at the TSF-26 site.

In addition to the wooden box full of soil discovered at the TSF-26 site during the 1995 OU 10-06 removal action, other buried unidentified wastes may be present at the site. Characterization of subsurface features at the site including the tanks themselves, piping to the tanks, the concrete cradles, sand, and monitoring tubes has been very limited. All of the metallic components at the site are expected to be radiologically contaminated at levels similar to that detected on the piping cut in 1981, although radiation levels may be higher in the tank bottoms. Cs-137, Sr-90, Co-60, and Eu-154 are the most likely beta and gamma-emitting radionuclides present in the piping. Alpha-emitting radionuclides may include uranium, plutonium, and americium isotopes, although the levels of these isotopes in the piping or tank components are unknown (LMITCO 1994).

The area of contamination at the site extends from the surface to the soil/basalt interface and includes the area where the tanks and concrete cradles are located, as well as the surrounding soils in an overall area of 30.5 by 21.3 m (100 by 70 ft). This is based on the results of the geophysical survey and the borings drilled during the 1988 DOE survey and the Track 2 investigation. Radionuclides (Cs-137 and Co-60) are the COPCs detected in the subsurface soils above ambient levels. Tributyl phosphate was detected; however due to its low frequency of detection, it is not considered a COPC. The assumption that the subsurface soils in the area are contaminated to the soil and basalt interface is very conservative because no sampling and analysis results are available below 5.2 m (17 ft) bgs. The estimated area of contamination is also conservative because the estimate is based on four soil borings that were drilled during the 1988 DOE survey. Although benzene and chloroethane were detected during the Track 2 sandpoint sampling, the Track 2 concluded these should not be considered COPCs because they were not detected in any of the numerous soil samples collected at the site. The results may, however, indicate potential release or spillage from the tanks to the protective cradle.

On the basis of historical information on site uses, the 1993 Track 2 investigation and the 1995 OU 10-06 removal action, all of the surface soils 0 to 0.8 m (0 to 2.5 ft) within the chain-link fence at the PM-2A site area assumed to be contaminated as well as the soil outside the fence extending to Firehold Road. Results of the 1996 soil samples collected during the OU 10-06 removal action the residual nature and extent of the contamination remaining at the TSF-26 site, and risks presented by that contamination are evaluated under this RI/BRA. The TSF-26 area was subject to removal, at which time it was discovered that the radiation levels exceeded the transportation limits for one load of soil. Approximately 1,700 yd^3 of soil were removed; however, the samples of stockpiled soil at the site were well above the 10-06 PRG of 16.7 pCi/g for Cs-137. The assumptions for the remaining contamination as well as the source-term estimates for TSF-26 are shown on Figure 4-31.

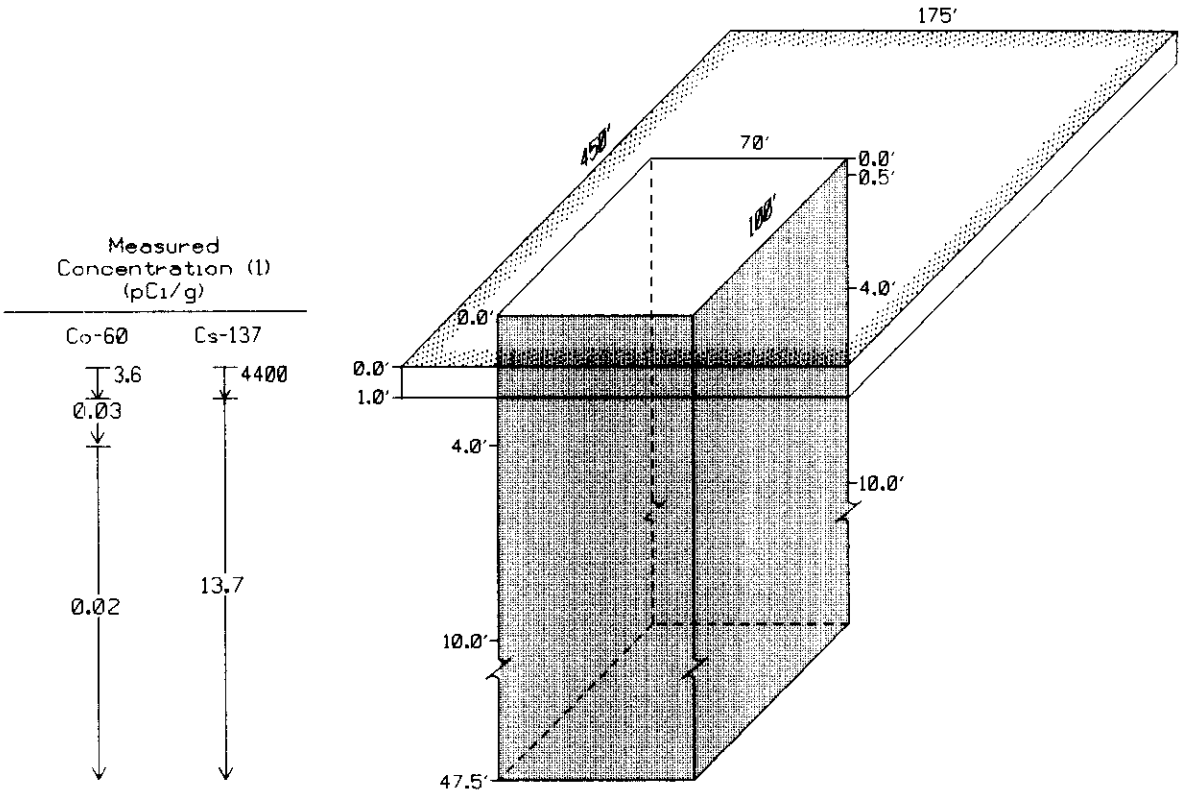
The COPCs at TSF-26 and TSF PM-2A, based on the contaminant screening process detailed in Section 6 and Table B-21, are shown in Table 4-16.

4.1.10 OU 1-06: TSF-07, Disposal Pond

4.1.10.1 Site Summary. TSF-07 is an unlined disposal pond located southwest of the TSF, as shown in Figure 4-32. The TSF-07 site encompasses a total area of approximately 35 acres, of which 5 acres in the northeast corner and on the eastern edge are believed to be contaminated with radionuclides and metals. The remaining 30 acres have never received wastewater and are not contaminated based on available screening data. The TSF-07 pond is unlined and surrounded by a 1.5-m (5-ft) berm. The active portion of the pond consists of a 1.5-acre main pond along the eastern edge. The overflow pond is a 1-acre pond along the northeast edge of the berm and has rarely been used. The TSF-07 disposal pond replaced the TSF-05 injection well and began receiving wastewater in September 1972. No radioactivity above background values was detected in a field survey of the western half of the TSF-07 pond performed in 1993. These results are interpreted to indicate that this end of the pond has not been used and that contaminants are not migrating horizontally from the contaminated eastern end of the pond.

The pond received wastewater from a variety of sources including sanitary waste discharges, low-level radioactive waste, cold process water, and treated sewage effluent originating from TAN service buildings and processes and, more recently, a one-time release of 40,000 gal of treated wastewater from TAN-726. Borated water was also transported from the LOFT facility and poured into a manhole leading into the pond when LOFT was operational. The wastewater was piped to and mixed in a common sump (TAN-655) and subsequently pumped to a concrete inlet basin in the northeast corner of the TSF-07 disposal pond. Wastewater was discharged to TSF-07 via a drainage ditch. The sediment thickness in the

TSF-26



Exposure Point Concentration (2) (pCi/g)			
Receptor/Pathway	Depth	Co-60	Cs-137
Occ (3) - Air	0-0.5'	3.6	4400
Occ (3) - External Rad.	0-4'	0.92	1108
Res (4) - All	0-10'	0.38	450
Res (4) - Groundwater	0>10'	0.09	103

LEGEND

Cs-137 contaminated soil area to 0.3 m (1 ft).

Cs-137 and Co-60 contaminated soil.

ASSUMPTIONS:

- The contaminated soil area to 0.3 m (1.0 ft) is the result of surface spills. The area and zone of contamination is accurate because the soil in the area was subject to removals in 1995 and 1996 and residual/stockpiled soil is still present on site.
- The area of contamination encompassing the tanks is the site area.
- The zone of contamination for the tanks is assumed from the surface to a depth of 14.48 m (47.5 ft) bgs. 14.48 m (47.5 ft) represents the midpoint to basalt.
- The volume of contaminated soil estimated in the 0 m (0 ft) to >3.05 m (10 ft) bgs interval has been corrected to account for tank volume of 18.9271 L (50,000 gal) (i.e. 189 m^3 [6685 ft^3]).

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest. These concentrations were area-weighted prior to the volume-weighting.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-31. OU 1-05: TSF-26 nature and extent assumptions.

Table 4-16. Summary statistics for TSF-26.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.06	3.6 +/– 0.3	1.02E–01	5.80E–02	19	19	100%	—	NA
Cs-137	0.17	4400 +/– 300	1.56E+01	2.84E+01	25	25	100%	1.28	18

J = Estimated

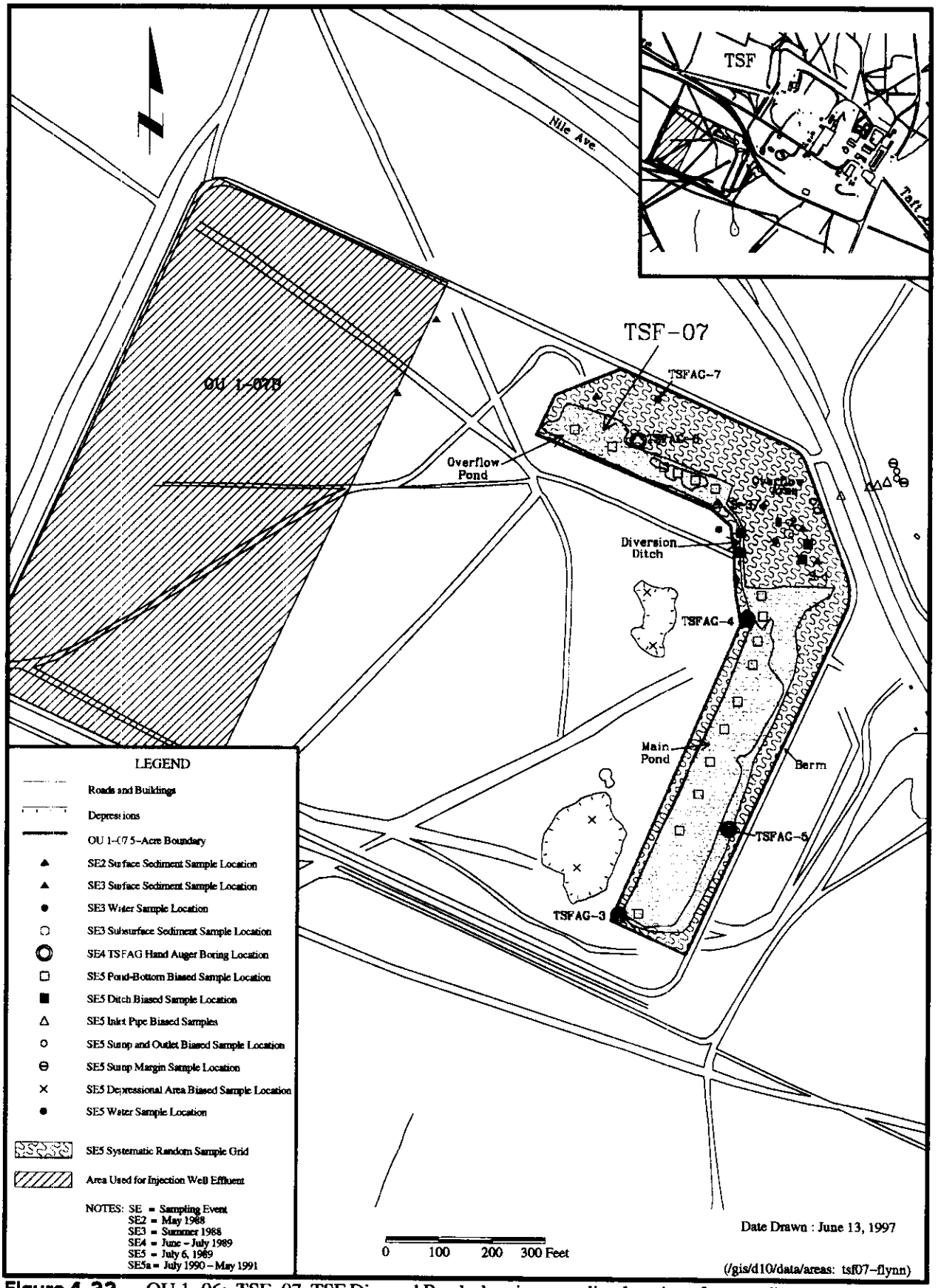


Figure 4-32. OU 1-06: TSF-07, TSF Disposal Pond, showing sampling locations for sampling events.

pond has been estimated to range from 7.5 m (24.5 ft) at well No. TAN-9, to 19.5 m (64 ft) at well No. TSFAG-07, with an average thickness of 13.7 m (45 ft).

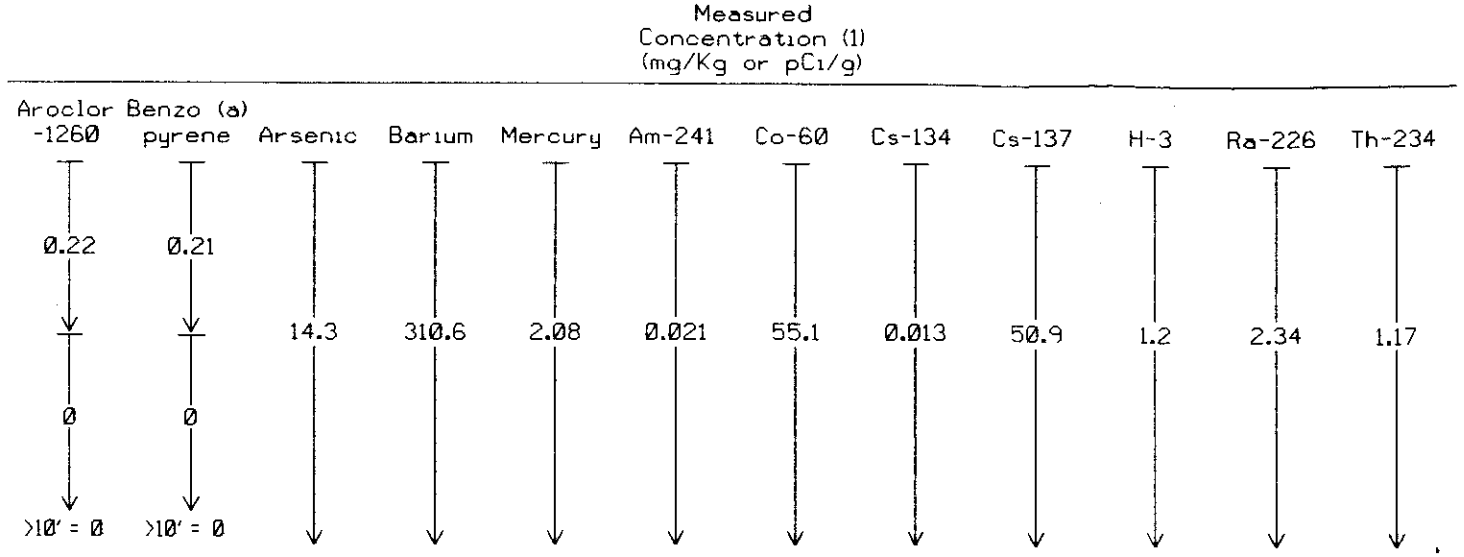
4.1.10.2 Previous Investigations. Results from samples of sludge in the common sump indicated the suspected contaminants for the TSF-07 are metals, SVOCs, VOCs, PCBs, Co-60, and Cs-137. Surface water, sediments, subsurface soil, and perched water associated with the TSF-07 disposal pond have been sampled from 1982 to 1991 (see Figure 4-33). The data for these events were summarized in the Track 1 decision document for TSF-07 and were considered to adequately characterize the occurrence of suspected contaminants given the common sump sample results and process knowledge associated with the wastewater disposed to TSF-07. Samples collected in 1988 were analyzed for the analytes found in 40 Code of Federal Regulations (CFR) Part 264, Appendix IX. Surface water and sediment samples collected in 1988 by the DOE environmental survey were analyzed for metals; VOCs; and select alpha-, beta-, and gamma-emitting radionuclides. The 1989 subsurface investigation characterized sediment, subsurface soil, and surface water. Perched water, attributed solely to the discharge of wastewater to TSF-07, was characterized in 1991.

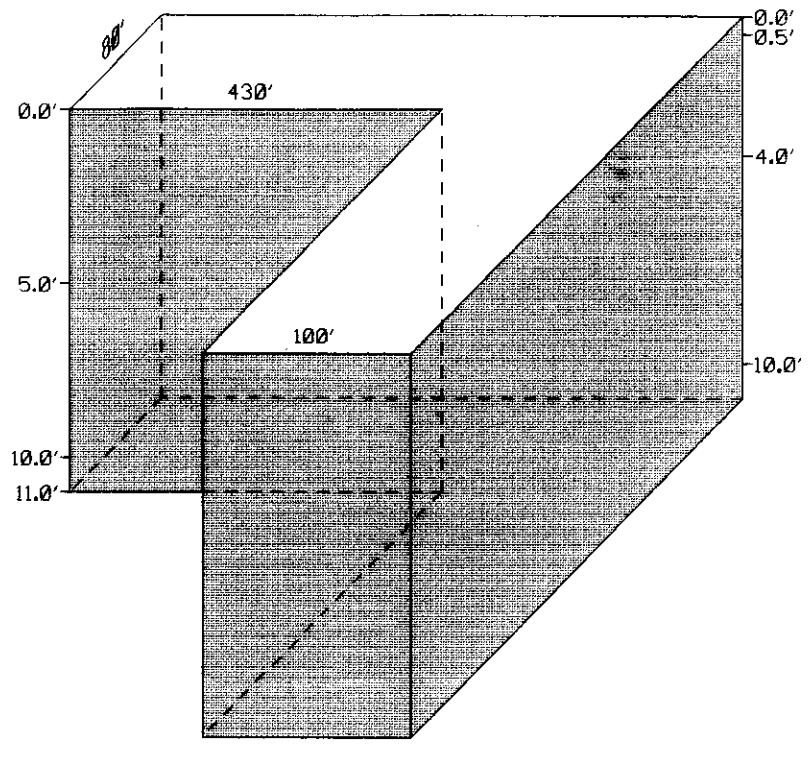
Approximately 129 samples have been collected during the course of these sampling events. The following paragraphs discuss the sample results for inorganic, organic, and radionuclide contamination with respect to sediment and subsurface soil. Surface water and perched water results are also discussed in the following paragraphs of this section.

The combined results of the previous investigations indicate that metals contamination has been detected in the pond sediment and subsurface soil and is assumed to exist up to a depth of 3.4 m (11 ft). Beryllium, chromium, mercury, and thallium are the most frequently (>34% of the samples) detected metals. Surface water data indicated the presence of beryllium, silver, and vanadium. Arsenic, antimony, thallium, and beryllium were detected in perched water samples; however, maximum concentrations were within an order of magnitude of Snake River Plain Aquifer (SRPA) background (when available) and were not detected consistently in the perched water samples (Medina 1993). The organic contaminants detected in soil samples at TSF-07 include toluene (0.07 mg/kg), aroclor-1254 (0.67 mg/kg), and aroclor-1260 (1.7 mg/kg). These contaminants were detected at depths of 0.6 m (2 ft). Acetone (0.24 mg/kg) and methylene chloride were detected at 7.9 m (26 ft) and 6.4 m (21 ft) bgs, respectively. All other detected organic contaminants were observed from 0 to 0.6 m (0 to 2 ft) bgs. Acetone was also detected in the surface water at a concentration of 11.0 μg/L. Organic contaminants were not detected in the perched water (Medina 1993).

As concluded in the evaluation of historical and analytical data on the TAN TSF-07 Disposal Pond (Medina 1993), Co-60, Cs-137, Cs-134, strontium (total), Am-241, Eu-155, and tritium were detected in the pond sediments and shallow subsurface soils at the site. Additionally, Co-60 and Cs-137 were detected in the subsurface soil from 3 to 3.4 m (10 to 11 ft) bgs. Surface water sample results indicated the presence of Am-241, Co-60, Cs-137, strontium (total), and tritium. Sr-90 has been detected in the perched water with concentrations ranging from 1.0 to 136 pCi/L. The average Sr-90 concentration in the perched water was approximately 13 pCi/L (Medina 1993).

The perched water beneath the TSF-07 disposal pond was encountered during the 1989 subsurface investigation for the TAN-RCRA Facility Investigation. Two of the borings that intercepted the perched water zone were converted into monitoring wells, and samples of the perched water were collected from these wells. The lateral extent of the perched water zone beneath TSF-07 has not been defined; however, monitoring indicates that the thickness of the zone varies from 2.7 to 12.2 m (9 to 40 ft). The occurrence of the perched water found in the two borings was in the surficial sediments above the basalt at





Exposure Point Concentration (2) (mg/Kg or pCi/g)													
Receptor/Pathway	Depth	Aroclor -1260	Benzo (a) pyrene	Arsenic	Barium	Mercury	Am-241	Co-60	Cs-134	Cs-137	H-3	Ra-226	Th-234
Occ (3) - Air	0-0.5'	0.22	0.21	14.3	310.6	2.08	0.021	55.1	0.013	50.9	1.2	2.34	1.17
Occ (3) - External Rad.	0-4'	0.22	0.21	14.3	310.6	2.08	0.021	55.1	0.013	50.9	1.2	2.34	1.17
Res (4) - All	0-10'	0.11	0.105	14.3	310.6	2.08	0.021	55.1	0.013	50.9	1.2	2.34	1.17
Res (4) - Groundwater	0>11'	0.10	0.10	13.0	310.6	2.08	0.021	55.1	0.013	50.9	1.2	2.34	1.17

LEGEND

Zone of contamination.

ASSUMPTIONS:

- Zone of metals & radionuclide contamination is assumed from the surface to 3.35 m (11 ft) bgs because of elevated radionuclide results at that depth.
- Zone of organic contamination is conservatively assumed to 1.52 m (5 ft) bgs because of the relative immobility of Aroclor-1260 and benzo (a) pyrene. These compounds were detected in samples from the 0 m (0 ft) to .61 m (2 ft) bgs interval.
- The entire overflow and main pond area is assumed to be contaminated at relatively low levels (i.e., hot spot contamination does not appear to be prevalent).

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.
(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.
(3) Occupational Scenario.
(4) Residential Scenario.
(5) The following COPCs were identified but do not have toxicity values: n-propylbenzene, phenanthrene, propeonitrile, tetrahydrofuran, sulfide, and thallium. Measured concentrations are summarized on Table 4-17.

Figure 4-33. OU 1-06: TSF-07, TSF Disposal Pond, nature and extent assumptions.

approximately 20 to 35 ft bgs. Perched water has been found in only two of the 14 boreholes and monitoring wells drilled near the pond since 1987. The perched water is present as a direct result of pond discharges. Once use of the pond is discontinued, the perched water zone will gradually dissipate into the subsurface basalt. The pond has 2.5 acres that remain active. The pond, considered a co-located facility receives treated sewage, boiler blowdown, and process waste water and is permitted for Land Application of Waste Water with the State.

4.1.10.3 Nature and Extent of Contamination. Based on the sampling results, an estimated 5 acres in the eastern and northeastern corner of the pond are known to be contaminated. The highest levels of contamination are found along the drainage ditch from the inlet basin in the northeast corner of TSF-07 to the main pond along the eastern berm. The main disposal pond is approximately 192 by 30.5 m (630 by 100 ft), or an area of 5,856 m^2 (63,000 ft^2). The overflow pond is approximately 131 by 24 m (430 by 80 ft), or an area of 3,144 m^2 (34,400 ft^2).

A conclusion of the Track 1 report is that vertical migration of contamination has occurred as evidenced by the elevated concentrations of metals in subsurface samples. The elevated radionuclide contamination appears to have occurred from the surface sediments to approximately 3.4 m (11 ft) bgs. Infiltration of wastewater at the site has likely increased the mobility of the metals and radionuclide contaminants that are routinely considered immobile (i.e., Cs-137). Organic contamination is assumed to be limited to the top 1.5 m (5 ft) of pond sediment with the exception of isolated acetone and methylene chloride detections at depth. Limited observations of contaminants in the perched water (i.e., Sr-90) also substantiate the sorption of contaminants within the pond sediments and underlying soil. The horizontal extent of contamination is limited to the main and overflow ponds. Contamination outside the TSF-07 has not been detected by field surveys.

Additionally, n-propylbenzene, phenanthrene, propionitrile, tetrahydrofuran, sulfide, and thallium are retained as COPCs due to the lack of toxicity information. These COPCs will be discussed in the uncertainty section. Based on Medina (1993) the zone of contamination for TSF-07 is dependent on the contaminant. For metals, the data indicate that contamination is likely near surface and similar to that for the radionuclides [i.e., 3.4 m (11 ft) bgs]. Radionuclide contamination is assumed to be limited to the top 3.4 m (11 ft) of pond sediment, while organic contamination is limited to the top 1.4 m (5 ft). Figure 4-33 shows the assumptions for the nature and extent of contamination as well as the source-term estimates for TSF-07.

The COPCs for TSF-07, based on the contaminant screening detailed in Section 6 and Table B-14, are shown in Table 4-17.

4.1.11 OU 1-06, TSF-08, Area 13B, Mercury Spill

4.1.11.1 Site Summary. TSF-08 Area 13B, a mercury spill, is located near the southwest corner of TAN-607, as shown in Figure 4-34. Mercury was used extensively at TSF-08 from the late 1950s to the early 1960s. The HTRE-III, part of the ANP program, used mercury as shielding for its reactor. From about 1959 to 1987, the HTRE-III engine was moved frequently along the railroad spurs between the test area at the IET facility and the maintenance areas at TAN-607 and TAN-647. The units were stored on the track near TAN-647 from the mid-1960s to 1987. It is reported that mercury leaked from the HTRE-III engine onto the ground and railroad system every time the unit was moved and that mercury beads were found on the soil near the TAN-647 storage location in the mid-1980s. Also, a large spill of mercury [3,028 to 3,785 L (800 to 1,000 gal)] reportedly occurred near the southwest corner of TAN-607 in 1958. Mercury spills were collected in buckets or simply vacuumed up until 1978. From 1978 to present, spills

Table 4-17. Summary statistics for TSF-07.

COPCs	Concentration (mg/kg or pCi/g) Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Arsenic	1.7	49.2 P	1.28E+01	1.02E+01	109	72	66%	7.4	56
Barium	152 P	9740 P	3.51E+02	1.02E+01	110	110	100%	440	4
Mercury	0.04 B CV	4040 N	4.09E+01	9.05E+02	111	79	71%	0.074	43
Sulfide	14.4 J	4270 N*J	3.24E+02	3.84E+02	37	23	62%	—	NA
Thallium	0.3 W	48.2 BJ P	1.43E+01	9.91E+02	107	53	49%	0.68	102
Aroclor-1260	0.22	1.7 J	3.27E-01	1.30E+01	20	6	30%	—	NA
Benzo(a)pyrene	0.21 J	0.21 J	2.18E-01	4.99E-01	20	1	5%	—	NA
n-Propylbenzene	0.014	0.014	1.40E-02	NA	1	1	100%	—	NA
Phenanthrene	0.17 J	0.17 J	2.16E-01	1.58E-01	20	1	5%	—	NA
Propionitrile	0.02	0.02	1.10E-02	1.58E-01	10	1	10%	—	NA
Tetrahydrofuran	0.016 BJ	0.022 BJ	1.83E-02	3.16E-03	3	3	100%	—	NA
Am-241	0.004 J	0.021 J	1.33E-02	3.21E-03	3	3	100%	0.019	1
Co-60	0.113 +/- 0.01	87.7 +/- 6.2	1.24E+01	8.62E-03	39	39	100%	—	NA
Cs-134	0.0131 +/- 0	0.0131 +/- 0	1.31E-02	NA	1	1	100%	—	NA
Cs-137	0.0516 +/- 0.01	135 +/- 10	1.45E+01	3.03E+01	55	55	100%	1.28	25
H-3	0.2 J	1.2 J	7.33E-01	5.03E-01	3	3	100%	—	NA
Ra-226	1.21 +/- 0.29	4.54 +/- 0.53	2.23E+00	5.95E-01	80	80	100%	—	NA
Th-234	0.535 +/- 0.19	1.8 +/- 0.34	1.01E+00	3.15E-01	16	16	100%	—	NA

P = ICP
B = Less than Contract Detection Limit but greater than or equal to Instrument Detection Limit.
C = Manual Spectrophotometric.
* = Duplicate analysis not within control limits.
J = Estimated.
F = Furnace AA.
N = Spiked sample recovery not within control limit.
W = Post-digestion spike for Furnace AA analysis is out of control limits (85–115%) while sample absorbance is less than 50% of spike absorbance.

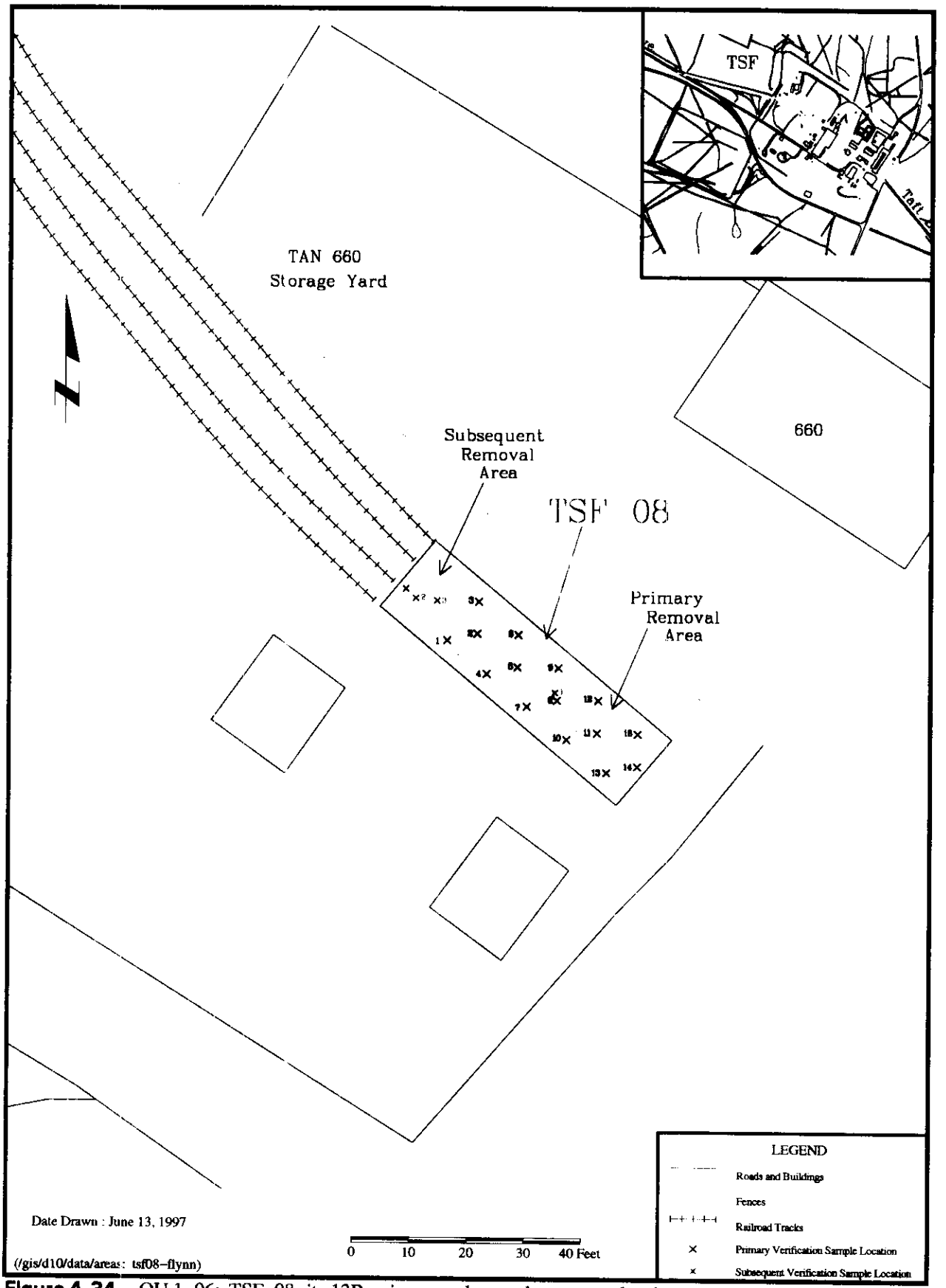


Figure 4-34. OU 1–06: TSF–08 site 13B, primary and secondary removal action.

were also monitored for gamma emitters before being collected. Since 1978, no collected mercury in the TSF area has been radiologically contaminated. The HTRE-III engine shield system contained a maximum of 19,782 kg (53,000 lb) of mercury, and mercury levels were maintained at capacity whenever the unit was moved.

4.1.11.2 Previous Investigations. TSF-08 Area 13B was originally included in OU 1-06, and a Track 1 was approved in June 1993 by the Environmental Protection Agency (EPA), the State of Idaho Department of Health and Welfare (IDHW), and DOE-Idaho Operations Office (DOE-ID) WAG 1 managers. A recommendation of the Track 1 report was to complete a removal action in the areas where free mercury and elevated mercury vapors were detected. The TSF-08 site was further addressed in the OU 1-05 Track 2 investigation where the risk evaluation results showed that site 13B posed a potential risk to human health and the environment.

Post-removal soil samples were collected from Area 13B and analyzed for mercury to assess if the removal action was effective (see Figure 4-34). Samples were also analyzed for gamma emitters because of the potential for contamination from the HTRE-III reactor. The OU 1-08 Track 2 investigation summarized these post-removal data and concluded that soil contamination at TSF-08 is limited to Area 13B; however, the levels were below the risk-based concentrations for mercury used in the Track 2 (i.e., 81 mg/kg). The area was then backfilled with 0.76 m (2.5 ft) of clean soil.

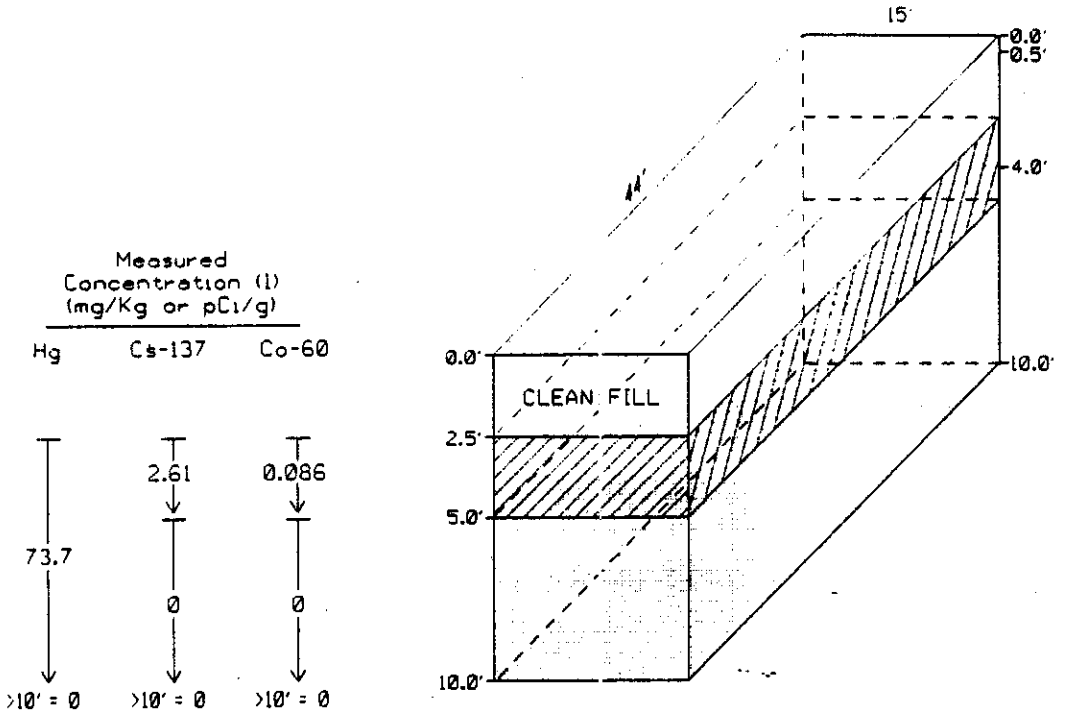
4.1.11.3 Nature and Extent of Contamination. Based on the sampling results contamination at TSF-08 Area 13B is assumed to be present at relatively low levels across the site with areal dimensions of 16.4 by 4.6 m (54 by 15 ft). Previous sampling and analysis indicate mercury contamination 4 ft bgs. The presence of mercury that was originally spilled on the ground surface at 4 ft bgs indicates vertical migration. Therefore, the vertical extent of mercury contamination is conservatively assumed to occur from 0.76 m (2.5 ft) bgs to a depth of 3.0 m (10 ft). The concentration of mercury is conservatively assumed to remain constant over the soil profile at the maximum detected concentration for the site because of the soil profile was not further characterized during the Track 2. Cs-137 was detected slightly above background and low activities of Co-60 were also observed in the post removal samples. The vertical extent of contamination for Cs-137 and Co-60 is assumed to be limited to the 0.76-m (2.5-ft) to 1.5-m (5-ft) because of relative immobility in the environment. Figure 4-35 shows the assumptions for the nature and extent of contamination as well as the source-terms estimate for TSF-08 Area 13B.

The COPCs for TSF-08 Area 13B, based on the contaminant screening process detailed in Section 6 and Table B-15, are shown in Table 4-18.

4.1.12 OU 1-07 A and B: TSF-05, Technical Support Facility Injection Well, and TSF-23, Contaminated Groundwater at Test Area North

4.1.12.1 Summary. The TSF-05 injection well is located just south of TAN-655 shown on Figure 4-36. The well was drilled in 1953 and completed to a depth of 93 m (305 ft) bgs. It is constructed of 30.5 cm (12 in.) diameter casing and is perforated from 55 to 74 m (180 to 244 ft) bgs and 82 to 93 m (269 to 305 ft) bgs. Depth to groundwater is approximately 63 m (206 ft) bgs at the site.

The well was used to dispose of liquid effluent generated from the ANP Program. It was last used as a primary disposal site in September 1972, after which wastewaters were diverted to the TSF disposal pond. Through the early 1980s, the well was placed on standby to be used for overflow from the sump at TAN-655. However, there are no records that indicate such overflows actually occurred. The well has not been used for waste disposal since.



Exposure Point Concentration (2) (mg/Kg or pCi/g)				
Receptor/Pathway	Depth	Hg	Cs-137	Co-60
Occ (3) - Air	0-0.5'	0	0	0
Occ (3) - External Rad.	0-4'	36.8	1.30	0.034
Res (4) - All	0-10'	59.0	0.78	0.026
Res (4) - Groundwater	0>10'	59.0	0.78	0.026

LEGEND

Zone of contamination for Cs-137 and Co-60.

Zone of contamination for Hg.

ASSUMPTIONS:

- The site was backfilled with .76 m (2.5 ft) of clean soil.
- The zone of contamination for mercury is assumed from .76 m (2.5 ft) bgs to 3.05 m (10 ft) bgs to provide for mobility of mercury.
- The zone of contamination for Cs-137 and Co-60 is from .76 m (2.5 ft) to 1.52 m (5 ft) because of the relative immobility of Cs-137 (the primary COPC) in the environment.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-35. OU 1-06: TSF-08, Mercury Spill Site 13B, nature and extent assumptions.

Table 4-18. Summary statistics for TSF-08 Area 13B.

	Concentration (mg/kg or pCi/g)								
COCPs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Mercury	0.4	73.7	2.56E+01	3.40E+01	5	5	100%	0.074	5
Co-60	0.086 +/– 0.01	0.086 +/– 0.01	8.60E–02	NA	1	1	100%	—	NA
Cs-137	0 +/– 0.27	2.61 +/– 0.2	8.70E–01	1.51E+00	3	3	100%	1.28	1

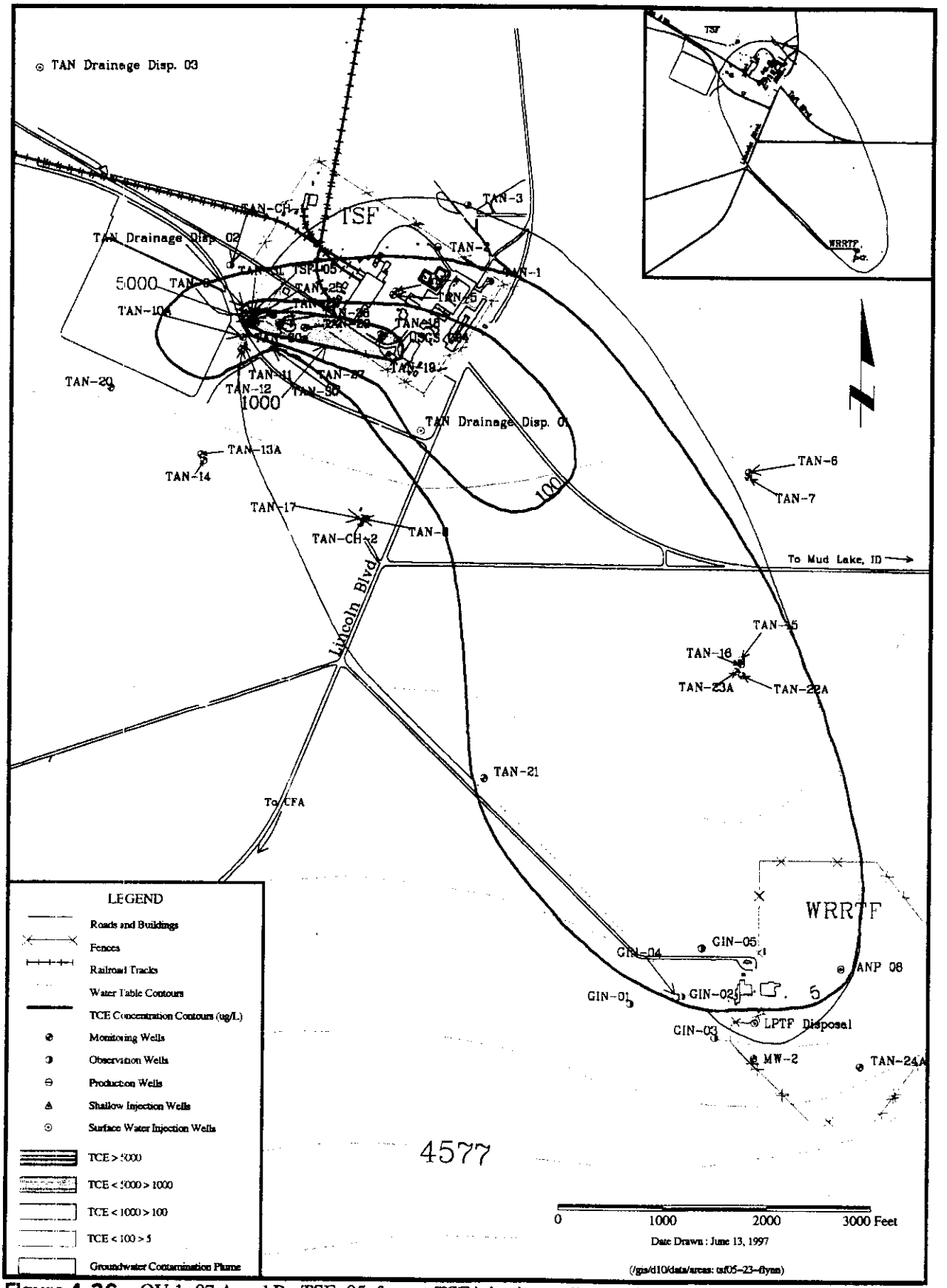


Figure 4-36. OU 1–07 A and B: TSF–05, former TSF injection well and TSF–23, TSF contaminated plume.

Discharge to the TSF-05 injection well included treated sanitary sewage, process wastewaters, and low-level radioactive waste streams. Hazardous wastes include corrosive and ignitable waste from shop operations and potentially corrosive and toxic condensate from the intermediate-level waste disposal system evaporator. Metals such as mercury, chromium, and lead are also suspected of being discharged to the well. Mercury usage was common in the late 1950s and early 1960s, while potassium chromate solution was used in decontamination activities after 1970. Lead shielding materials were also decontaminated with corrosive solutions, which were discharged to the well. The TSF-05 injection well also received low-level radioactive waste streams.

Historical records provide little definitive information on the types and volumes of organic waste disposed to the injection well. However, based on usage rates at facilities that discharged to well TSF-05, as much as 97,161 L (25,670 gal) of trichloroethylene may have been disposed to the well.

In 1990 an initial effort was made to remove process sludge from the bottom 17 m (55 ft) of the TSF-05 Injection Well. Analytical results showed that the removed sludge (approximately 8 drums) contained high levels of organic contaminants (2% trichloroethylene) and radionuclides. In September 1992 the Interim Action Record of Decision (ROD) was signed. The objectives of the Interim Action were to reduce contaminant levels near the TSF-05 Injection Well and the surrounding ground water, and to measure aquifer parameters based on data from groundwater extraction and new monitor wells. To meet this objectives an onsite Groundwater Treatment Facility (GWTF) was installed with the selected treatment of recovered groundwater being air stripping, carbon adsorption, and ion exchange. Additionally, two groundwater monitoring wells were installed to track the effectiveness of the system. In August 1995 the final action ROD was signed for TSF-05 and the surrounding groundwater. The prescribed ROD remedy was for surge and stress of the TSF-05 well to remove secondary source (Phase A) with subsequent hydraulic containment (Phase B) of the greater than 5,000 µg/L plume. In November 1996 Phase B of the ROD was implemented at which time the GWTF began operations in the continuous mode in order to achieve hydraulic containment. In support of Phase B two additional groundwater monitoring wells were installed in 1996 and three more planned for 1997. The Remedial Design Remedial Action Work Plan implementing Phase C of the ROD is scheduled to be submitted in August 1999 and is designed to address the dissolved portion of the contaminant plume.

4.1.12.2 Previous Investigations. Groundwater sampling has been conducted at TAN since 1949. The purpose of sampling prior to the 1980 was to provided background water quality information (Bagby et al. 1984). In 1980 the EPA recommended that DOE request the U.S. Geologic Survey (USGS) to begin an installation wide groundwater monitoring program for organic constituents. In response, the USGS began monitoring selected wells, including several wells at TAN, for organic solutes.

Releases to TAN groundwater were first detected in 1987 when low levels of the organic compounds trichloroethylene and tetrachloroethene were detected in TSF production wells. Further sampling of the TAN water supply wells confirmed the release of trichloroethene to groundwater. In response to this release, DOE implemented a corrective action plan to reduce contaminant levels and to protect TAN personnel. The actions that were performed included the installation of an air sparging system on the drinking water supply system and the removal of 17 m (55 ft) of contaminated sludge from well TSF-05.

Although well TSF-05 had been suspected of being a source of contamination, DOE initiated a RCRA Facility Investigation in 1989 to definitively identify the source of the release. Additional goals of the RCRA Facility Investigation were to determine the nature and extent of contamination at TAN. Activities conducted as part of the investigation included the installation and sampling of additional groundwater monitoring wells. Well installation and sampling activities continued under the RCRA

Facility Investigation until 1992 at which time RCRA Facility Investigation activities were incorporated into an RI/FS program.

4.1.12.3 Nature and Extent of Contamination. TSF-05 has undergone an interim action and the final remedial action is underway. Based on the sampling results, VOCs, primarily trichloroethylene, are the major contaminants of concern (COCs) at TAN, and the most widespread (see Figure 4-36). The radionuclides, Sr-90, Cs-137, and tritium, are also present at concentrations of concern but are not as widely distributed as the VOCs. While it cannot be unequivocally stated that other injection wells such as the WRRTF-05 are not contributing contaminants to groundwater, all available data indicate that well TSF-05 is the principle source of contamination at TAN.

Extensive drilling, aquifer testing, and sampling have shown that the majority of the groundwater contamination is limited to the uppermost groundwater system underlying TAN. Below this uppermost hydrostratigraphic unit an impermeable layer, the Q-R interbed, prevents contaminant migration to lower hydrogeologic units. The Q-R interbed is located at a depth of 134 m (440 ft) bgs, or 40 m (131 ft) below the bottom of the lower screened interval of well TSF-05. As a result of these investigative efforts, the extent of groundwater contamination has been fairly well delineated both horizontally and vertically in the aquifer underlying the TAN area.

The selected remedial action for TSF-05 is groundwater plume extraction and treatment of the greater than 25 μg/L trichloroethylene plume and hydraulic containment of the TSF-05 Injection Well hotspot with aboveground treatment. The reasonable timeframe for restoration of the aquifer to drinking water standards should not exceed 100 years. The TSF-05 Injection Well hotspot is the subsurface area in the immediate vicinity of the injection well containing the highest concentrations of dissolved contaminants as well as undissolved residual contaminants. The selected remedial action will be conducted in three phases as documented in the ROD for this site. In general the phases are:

- Phase A—Remove as much of the secondary source as possible from the vicinity of the TSF-05 Injection Well by physically and hydraulically stressing the well.

- Phase B—Prevent to maximum extent practicable, migration of contaminated groundwater beyond the hotspot at levels above maximum contaminant levels (MCLs), or for those contaminants for which an MCL does not exist, the contaminant concentration will be such that the total excess cancer risk posed by release of contaminated groundwater will be within the acceptable range of 10^{-4} to 10^{-6}.

- Phase C—Capture and/or treat a sufficient portion of the dissolved phase plume beyond the hotspot to provide for aquifer cleanup within 100 years for the data of ROD signature.

- Institutional controls and groundwater monitoring—Institutional controls shall be implemented to protect current future users from health risks associated with ingestion of groundwater containing contaminants of concern concentrations greater than MCLs or 10^{-4} to 10^{-6} risk-based concentrations for contaminants without MCLs. Institutional controls shall be maintained until COC concentrations fall below MCLs or 10^{-4} to 10^{-6} risk-based concentrations for contaminants without MCLs.

In respect to the contamination associated with TSF-05 and the surrounding groundwater, this BRA assumes that the remedial action objectives (RAOs) established in the OU 1-07B ROD will be met in the

100 year time frame and therefore will only evaluate risk from the residual risk from the COCs at their prescribed concentration level. This is further discussed in Sections 6.3 and 6.5.

4.1.13 OU 1-08: TSF-22, TSF Railroad, Turntable

4.1.13.1 Site Summary. TSF-22 consists of contaminated soil beneath the TAN-705 railroad turntable located in the western portion of the TSF, as shown in Figure 4-37. The turntable is a wooden structure, 27 m (90 ft) in diameter, which is supported by concrete foundation piers. The wooden deck covers a pit, approximately 2.1 m (7 ft) deep, which has a gravel bottom. The turntable was built in 1954 and was used to transport HTRE dollies (air-cooled nuclear reactors) between facilities until 1961, when the program was canceled. The tracks were then used to transport equipment associated with the System for Nuclear Auxiliary Power Transients Program (SNAPTRAN) Program until 1967 and equipment from the LOFT area from 1972 to 1990. Contamination present at TSF-22 is attributed to contaminant releases from HTRE dollies or SNAPTRAN equipment onto the turntable or through the wooden planks into the pit below. Contaminated equipment associated with the LOFT Program and transported on the railroad tracks would have been contained to prevent the spread of radioactivity. The contaminants associated with the HTRE dollies and the SNAPTRAN Program are mercury, Co-60, Cs-137, Sr-90, and U-235. Mercury was used as shielding on the HTRE dollies. The radionuclides are those identified in sampling at the IET area, where the HTRE and SNAPTRAN programs were based.

4.1.13.2 Previous Investigations. In the 1980s, the 591 m^2 (6,362 ft^2) of wooden planking on the turntable was replaced. A number of radioactive "hot spots" were detected on the original planking. These were removed and disposed of as low-level radioactive waste at the RWMC. The remaining planking was disposed of at the CFA landfill. A radiological survey of the new turntable deck and adjacent railroad tracks was performed in 1992. Beta/gamma radiation, measured with a handheld detection device, was 8.0E02 cpm to the west and 3.0E02 cpm to the east of the turntable; none was detected on the turntable itself. Background is considered approximately 1E02 cpm in this area.

Five soil samples were collected below the turntable in 1993 as part of the OU 1-08 Track 2 investigation preliminary scoping. The samples were collected at a depth of 3 to 15 cm (1 to 6 in.) and analyzed for gross alpha, gross beta, and gamma-emitting radionuclides and mercury. This analytical suite encompassed all suspected contaminants given the operational history at TSF-22.

Analytical results of the soil sampling indicated that mercury concentrations ranged from 1.7 to 4.4 mg/kg. Cs-137 was detected in all of the samples and ranged from 0.76 ± 6.0E–02 pCi/g to 3.18 ± 2.6E–01 pCi/g; Co-60 was detected in one sample at 0.12 ± 2.0E–02 pCi/g; U-235 was not detected.

4.1.13.3 Nature and Extent of Contamination. Based on the sampling results, Cs-137 and mercury are the primary contaminants detected in soils at TSF-22; however, mercury concentrations are below the risk base screening level of 23 mg/kg so it was therefore screened out. Concentrations of other radioactive contaminants at TSF-22 are either not detectable (U-235), below background levels (gross alpha and beta), or are detected infrequently and only slightly elevated above background levels (i.e., Co-60). The contaminated area is estimated at 1,341m^2 (14,440 ft^2), the area of the turntable that defines site TSF-22. The vertical extent of mercury contamination assumed from the surficial sample results is 3 m (10 ft). Given the limited mobility of Cs-137, the zone of contamination is assumed to extend from the surface for a depth of 0.8 m (2.5 ft). Figure 4-38 shows the assumptions for the nature and extent of contaminants as well as source-term estimates for TSF-22.

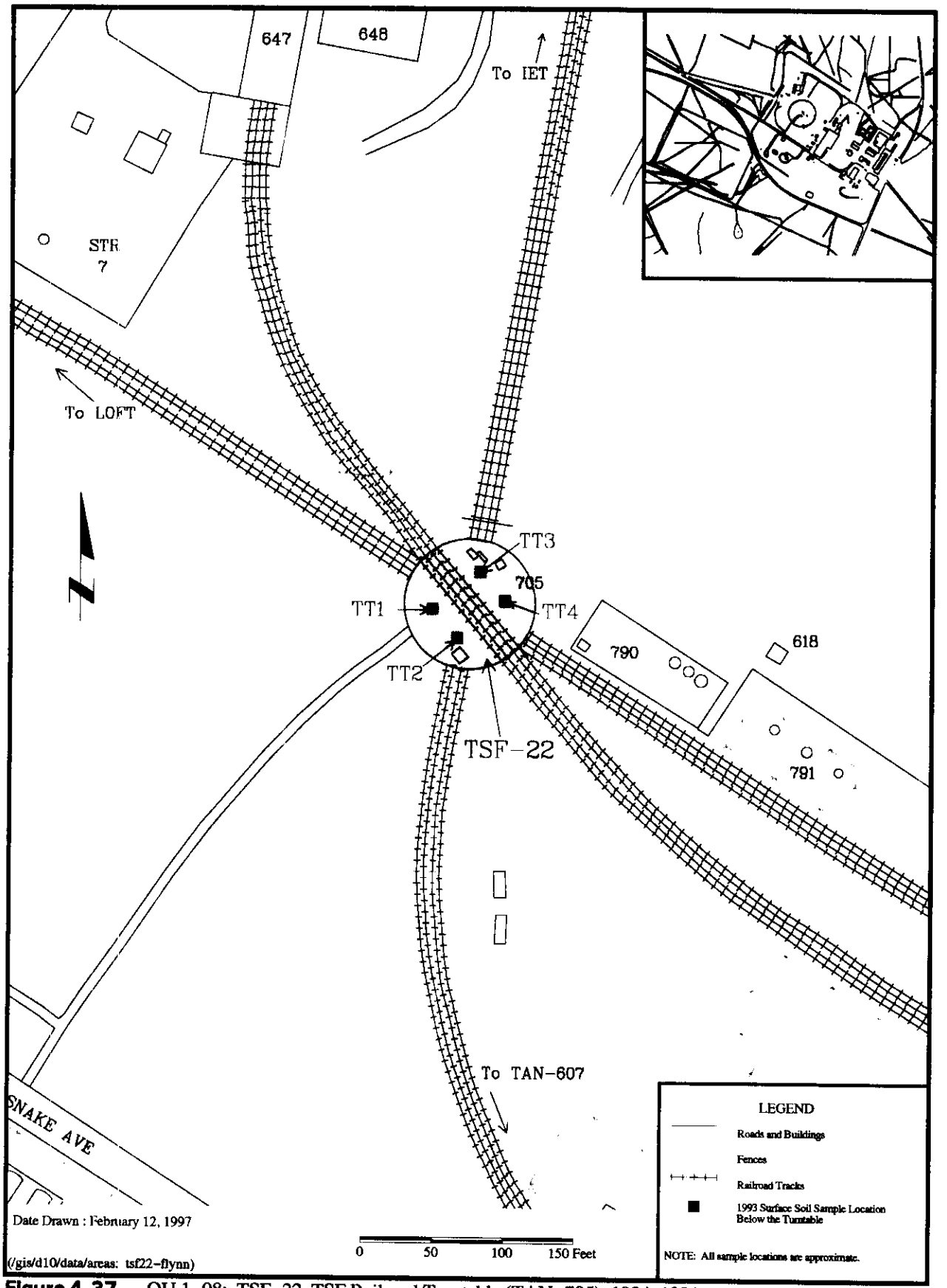
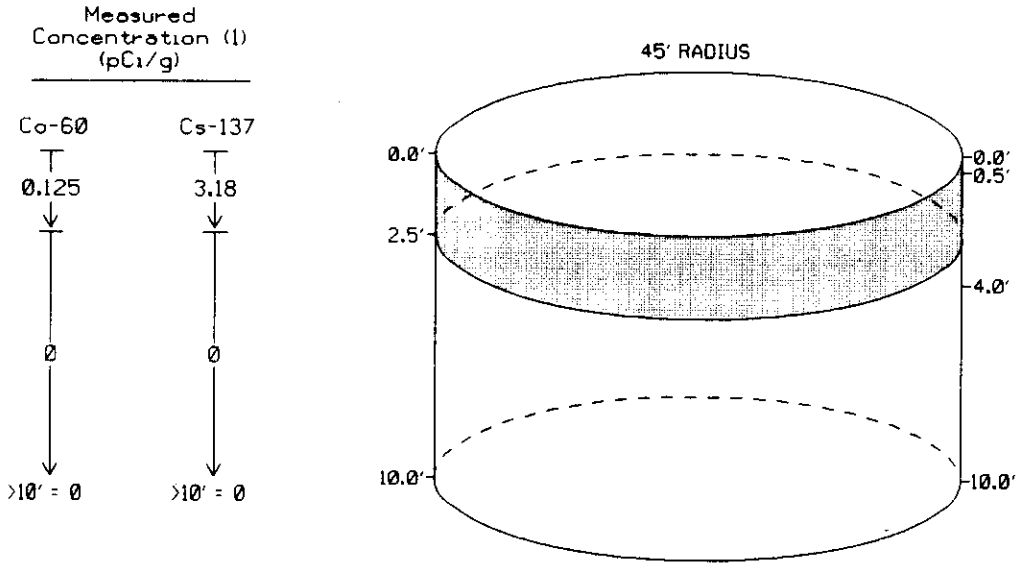


Figure 4-37. OU 1–08: TSF–22, TSF Railroad Turntable (TAN–705), 1984, 1991, and 1993 sampling locations.



Exposure Point Concentration (2) (pCi/g)			
Receptor/Pathway	Depth	Cs-137	Co-60
Occ (3) - Air	0-0.5'	3.18	0.125
Occ (3) - External Rad.	0-4'	2.385	0.938
Res (4) - All	0-10'	0.954	0.025
Res (4) - Groundwater	0>10'	0.954	0.025

LEGEND

Zone of contamination for Cs-137.

ASSUMPTIONS:

- The area of contamination is assumed to be the area below the turntable.
- The zone of contamination for Cs-137 is assumed to be from the surface to .76 m (2.5 ft) bgs because of the relative immobility of Cs-137 (the primary COPC) in the environment.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-36. OU 1-08: TSF-22, TSF Railroad Turntable (TAN-705), nature and extent assumptions.

The COPCs for TSF-22, based on the contaminant screening process detailed in Section 6 and Table B-20, are shown in Table 4-19.

4.1.14 WRRTF-05, Injection Well

4.1.14.1 Site Summary. The WRRTF injection well is located 84 m (280 ft) south of WRRTF as shown in Figure 4-39. WRRTF-05, a 94-m (313-ft) deep injection well was constructed in the late 1950s and became operational in 1957. The well has a 25.4-cm (10-in.) diameter steel casing along the full depth of the well. According to a construction diagram, the casing is perforated between 57 and 94 m (189 and 313 ft). Outside the steel casing is a 2.54-cm (1-in.) monitoring pipe within the gravel pack of the 40.6-cm (16-in.) diameter borehole.

The WRRTF-05 injection well was used for disposal of process and sanitary waste from WRRTF facilities from 1957 to 1984. The well is reported to have received approximately 170,100 L (45,000 gal) of effluent per day during this period. The major sources of liquid chemical waste sent to the injection were from water demineralization, ion-exchange-column regeneration, water softening, and corrosion and scaling control in boiler and cooling waters. Chemicals used in these activities included sodium chloride, sodium hydroxide, sulfuric acid, sodium sulfite, sodium hydrogen phosphate, and sodium phosphate. The injection well may also have received hydrazine, used as an oxygen scavenger in cooling water at WRRTF for a number of years, although facility records indicate none was disposed of in the well. Two small-quantity, one-time releases of approximately 50 mCi of Co-60 in 1969 and 212 L (56 gal) of turbine oil have been documented as released to the well (INEL 1995).

The injection well became blocked in March 1984 at about 51 m (170 ft) bgs, as indicated by a videotape made of the well interior. Use of the well was discontinued, and in September 1984, the well was abandoned in place. The casing within the concrete sump was cut and welded shut, and the sump was filled with concrete to above the top of the highest inlet pipe. In September 1993, during measurement of the water level in the monitoring pipe next to the injection well, petroleum product was discovered at 64 m (212 ft) bgs. It was estimated that 1.8 to 3.6 m (6 to 10 ft) of oil was present in the pipe. The oil product was not believed to be associated with processes at WRRTF-05, and the product was designated as a new site WRRTF-13. Even though the sampling activities at the injection well were performed as part of the Phase III sampling of WRRTF-13, the results and discussion referred to the Track 2 process associated with WRRTF-05.

4.1.14.2 Previous Investigations. The Track 2 investigation process for the WRRTF-05 site was begun in December 1993 and during scoping meetings held in 1993 and 1994, it was decided to reconstruct the well to collect samples.

In January 1994, the sump above the well was excavated and removed. Inlet pipes to the sump were cut and capped, and materials found in the pipes as well as soil from around the perforated well cap were sampled. Analysis for VOCs, SVOCs, and metals detected no contaminants. A sample of the oil in the monitoring well was also obtained and analyzed using gas chromatography. On the basis of a comparison to known laboratory standards the oil was determined to be No. 1 fuel oil or diesel oil. A new standpipe was welded onto the well to raise the wellhead to the ground surface. The well itself was found to be blocked at approximately 52 m (171 ft) bgs. A video log taken of the well indicated extensive corrosion of the well casing down to the water table level of 50 m (167 ft).

Table 4-19. Summary statistics for TSF-22.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Co-60	0.125 +/- 0.02	0.125 +/- 0.02	1.25E-01	NA	1	1	100%	—	NA
Cs-137	0.763 +/- 0.06	3.18 +/- 0.26	1.25E+00	1.02E+00	5	5	100%	1.28	1

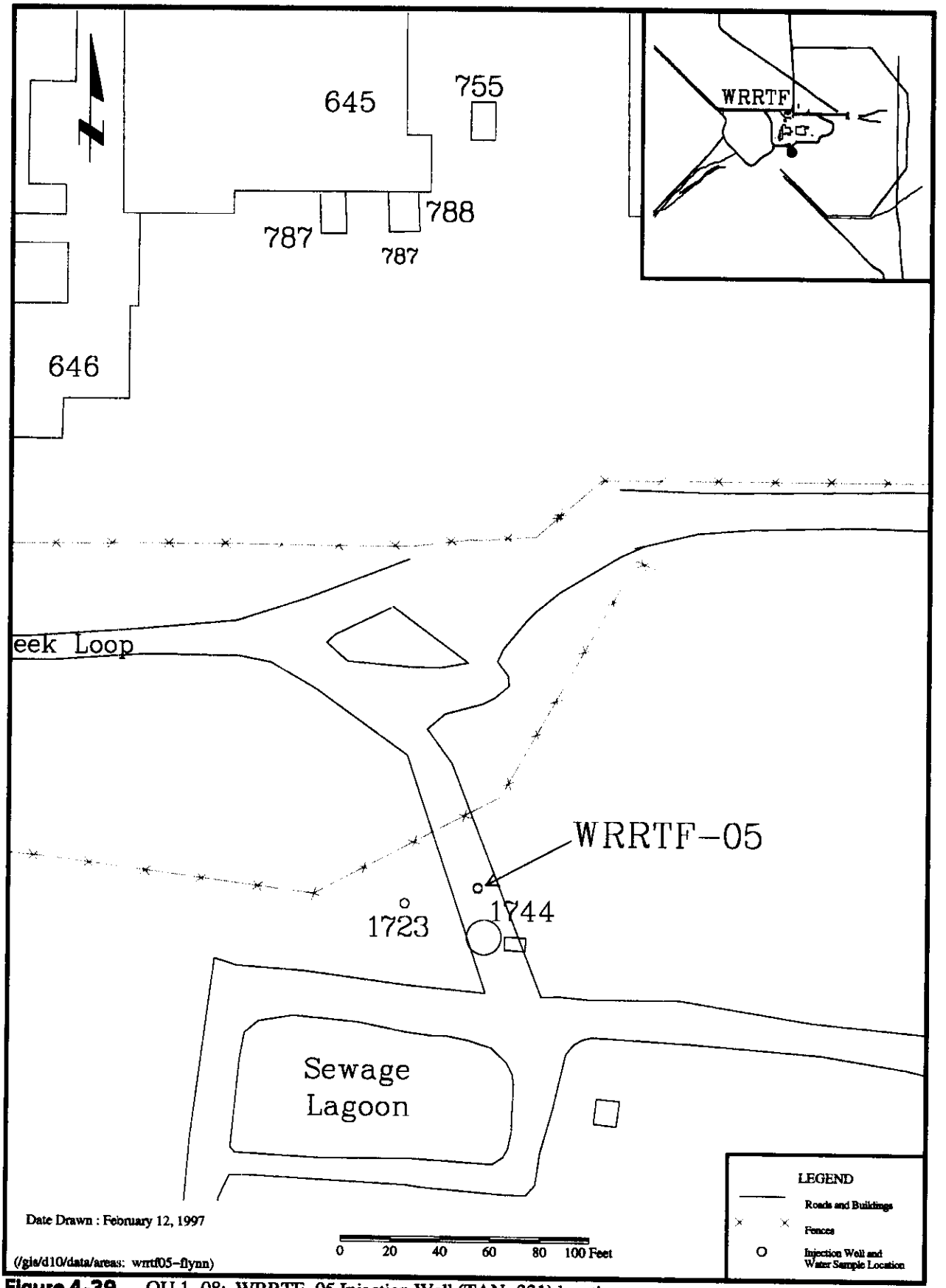


Figure 4-39. OU 1–08: WRRTF–05 Injection Well (TAN–331) location.

In March 1994, the well was cleaned out by forcing materials out into a tank using compressed air. From approximately 55.5 to 66 m (185 to 220 ft) bgs, soil and rocks, which appeared to be contaminated with a petroleum product, were recovered from the well. This material as well as the water recovered from the well were sampled. Although it seems likely that the petroleum product contamination detected is related to the diesel fuel found in the monitoring tube, it is possible that the product is residual contamination from the reported release of 212 L (56 gal) of turbine oil into the well in the 1960s. The unvalidated water sample results indicated no alpha- or gamma-emitting radionuclides; gross beta activity was 7.1 ± 1.6 pCi/L. The concentrations of metals in the water were below the MCLs, MCL goals, and secondary MCLs with the exception of antimony, iron, and manganese. The concentrations of these detected in the water were 22 mg/L (antimony) 2,320 mg/L (iron) and 0.083 mg/L (manganese). Bis(2-ethylhexyl)phthalate, 2,6-dimethylphenol, acetone and four TICs were detected at low concentrations (2 to 19 µg/L) in the VOC and SVOC analyses. The concentrations of cadmium, chromium, copper, iron, mercury, lead, and zinc in the sediment removed from the well appear elevated compared to TAN baseline concentrations. In addition, numerous organic compounds were detected in the sludge.

During the OU 1-08 Track 2 investigation (LMITCO 1995), groundwater samples were taken from the WRRTF-05 well in April and July 1994. During the July sampling to collect a VOC sample, a dark, oily substance was observed to be dripping down the sides of the bailer. The contents of the bailer was a single aqueous phase that varied from clear in appearance at the bottom of the bailer to a very light tan with floating particle matter at the top. By contrast, all of the samples collected from the sampling manifold were clear and particulate-free. There was not enough of the substance present on the bailer to be sampled for laboratory analysis. The source of the material is unknown.

The OU 1-08 Track 2 investigation (LMITCO 1995) identified the contaminants for the site as the hazardous constituents associated with general industrial wastewater. To characterize potential groundwater contamination associated with WRRTF-05, the collected samples were analyzed for metals, VOCs and SVOCs, pesticides and PCBs, herbicides, gamma spectrometry, and gross alpha and beta radionuclides.

The OU 1-08 Track 2 sampling results supported the results of the preliminary scoping and evaluation of available process and historical data, indicating that the quantity and nature of materials disposed of in the WRRTF-05 injection well did not result in contamination of the groundwater. The exception to this may be low levels of manganese. No contaminants detected in the groundwater samples were human carcinogens.

During all three sampling events associated with the Track 2, the concentration of manganese detected had been approximately an order of magnitude greater than manganese concentrations typically seen in groundwater at TAN or the INEEL. The final RI report for the OU 1-07B (EG&G 1994) contains the results of groundwater monitoring of TAN and shows manganese concentrations in other TAN wells. It is possible that manganese in demineralizer wastewaters has precipitated out and became encrusted on the well casing. This observation is supported by the elevated manganese levels seen in other injection wells at TAN.

Three additional sampling events have been performed since the OU 1-08 Track 2 investigation sampling events. In December 1994 the injection well was sampled to determine whether any petroleum product had entered the well following the July 1994 sampling, a 5-month period. No oil was observed during this sampling event. No CLP TCL VOCs, SVOCs, pesticides, PCBs, or herbicide target compounds were detected in the samples. Gross beta activity in the sample was 7.6 ± 1.8 pCi/L. No gamma-emitting radionuclides or gross alpha activities were detected. CLP metals detected in the sample

at low concentrations were barium, calcium, copper, iron, magnesium, manganese, potassium, sodium, and zinc.

WRRTF-05 was sampled again in February 1995. This time, the well was sampled from depths of 65.5 m (215 ft) prior to purging the well and from 74 m (243 ft) after purging the well. The samples taken prior to purging were analyzed for CLP VOCs and SVOCs. The samples taken after purging were analyzed for CLP VOCs, SVOCs, metals, and pesticides, PCBs, herbicides, and gamma-, beta-, and alpha-emitting radionuclides.

No gamma- or alpha-emitting radionuclides were detected. Gross beta activity in the sample was 6.5 ± 1.9 pCi/L. No pesticides, PCBs, or herbicide target compounds were detected in the samples. Bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was the only target compound detected in the SVOC analysis.

4.1.14.3 Nature and Extent of Contamination. Based on the sampling results, in the VOC analysis of the sample collected from 72.9 m (243 ft) bgs, dibromochloromethane, 1,1,2,-trichloroethane, bromoform, 4-methyl-2-pentanone, 1,1,2,2-tetrachlorethane, ethylbenzene, and xylene were detected at low concentrations. The CLP metals detected in the samples included aluminum, barium, calcium, copper, iron, magnesium, manganese, potassium, sodium, and zinc. During the OU 1-10 RI/FS scoping meetings in May 1995, it was decided that at least one additional sampling event should be performed, and, as previous sampling events, two samples were collected prior to purging the well and two samples were collected after purging. No visual indication of floating product was observed. Analysis of the samples resulted in detections at or below the detection limit for the following contaminants: benzo(b)fluoranthrene, benzo(k)fluoranthrene, benzo(a)pyrene, acenaphthene, trichloroethene, tetrachloroethane, naphthalene, 2-methylnaphthalene, 1,3- and 1,4-xylene, ethylbenzene, 1,2-xylene, isopropylbenzene, N-propylbenzene, 1,3,5-trimethylbenzene, tert-butylbenzene, 1,2,4-trimethylbenzene, and di-n-octylphthalate. No contaminants were detected above drinking water standards and many of the positive results were considered estimated because the reported concentrations were below the CRQL.

The sampling of the well has not resulted in a definitive determination of the source of the contamination; however, there is no indication that a continuing source of contamination is present in the vicinity of WRRTF-05. This site is not furthered evaluated in the BRA.

The contaminants that were detected during the OU 1-10 RI/FS sampling of the well are shown in Table 4-20.

4.1.15 OU 1-08: WRRTF-13, WTTRF Fuel Leak

4.1.15.1 Site Summary. There have been numerous diesel and heating fuel tanks and transfer lines used at WRRTF during its operational life. Most of these tanks and lines have been taken out of service and removed. Currently, there is one active diesel fuel tank at WRRTF, a 22,711-L (6,000-gal) stainless steel tank that replaced Tank TAN-738 when it was removed in 1991. Residual contamination remains in the subsurface because of leaks and spills of diesel fuel at the former locations of tanks TAN-738, TAN-739, and TAN-787 and the transfer piping between tanks TAN-787 and TAN-738 as shown on Figure 4-40.

When the 3,785-L (1,000-gal) stainless steel tank, TAN-739, was removed in 1990, approximately 22.9 m^3 (32 yd^3) of contaminated soil was also removed. Because of the possibility of damaging a second UST located near the tank, not all of the contaminated soil present was removed. Analytical results for

Table 4-20. Summary statistics for WRRTF-05.

	Concentration (µg/L or pCi/Ll)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
1,2,4-Trimethylbenzene	0.1 J	0.3 J	2.75E–01	1.71E–01	4	3	75%	—	NA
1,3,5-Trimethylbenzene	0.1 J	0.1 J	4.00E–01	2.00E–01	4	1	25%	—	NA
2-Methylnaphthalene	0.9 J	0.9 J	3.97E+00	2.05E+00	4	1	25%	—	NA
Acenaphthene	0.6 J	0.6 J	6.45E+00	3.08E+00	8	1	12.5%	—	NA
Benzo(a)anthracene	0.22	0.22	2.55E+00	2.62E+00	8	1	12.5%	—	NA
Benzo(a)pyrene	0.27	0.27	2.58E+00	2.59E+00	8	1	12.5%	—	NA
Benzo(b)fluoranthene	0.19	0.19	2.56E+00	2.61E+00	8	1	12.5%	—	NA
Di-n-octylphthalate	1 J	1 J	4.00E+00	2.00E+00	4	1	25%	—	NA
Dichlorodifluoromethane	0.1 J	0.2 J	2.25E–01	1.89E–01	4	3	75%	—	NA
Isopropylbenzene	0.1 J	0.1 J	4.00E–01	2.00E–01	4	1	25%	—	NA
n-Propylbenzene	0.1 J	0.1 J	4.00E–01	2.00E–01	4	1	25%	—	NA
Naphthalene	1	2	4.83E+00	3.43E+00	12	5	42%	—	NA
sec-Butylbenzene	0.1 J	0.2 J	1.50E–01	5.77E–02	4	4	100%	—	NA
tert-Butylbenzene	0.1 J	0.1 J	4.00E–01	2.00E–01	4	1	25%	—	NA

J = Estimated

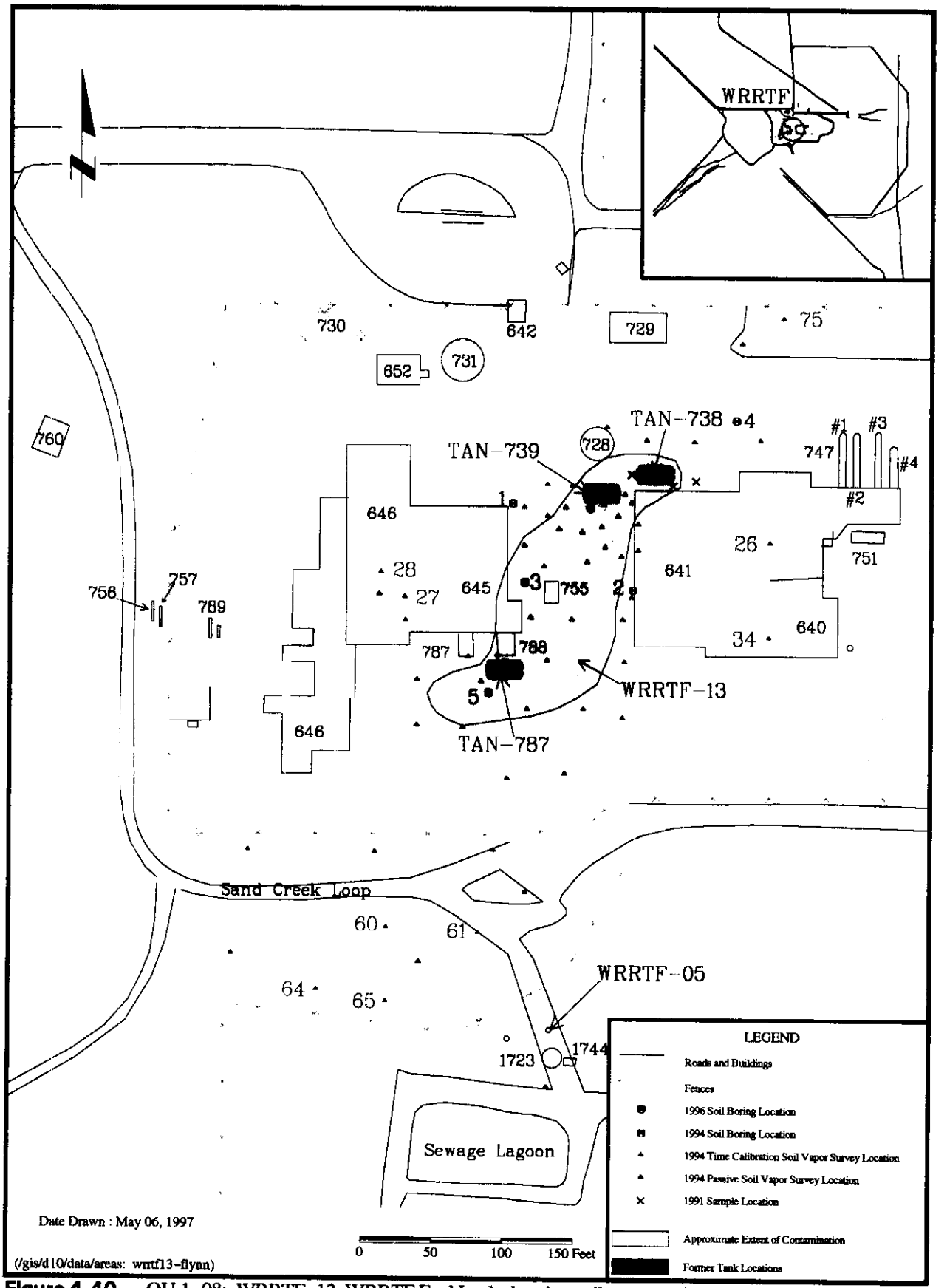


Figure 4-40. OU 1–08: WRRTF–13, WRRTF Fuel Leak showing soil vapor and soil boring locations from 1991, 1994, and 1996.

samples collected from the tank excavation following the tank removal indicate diesel fuel contamination remained in the soils below the excavation. TAN-738, located approximately 3 m (10 ft) east of TAN-739, was installed in 1959 and used to supply heating oil to the boilers in Building TAN-641. In 1963 Tank TAN-787 was installed. It was connected to Tank TAN-738 in 1976 when a 3.8-cm (1.5-in.) stainless steel line was installed, along with new boilers in Building TAN-641. The tanks and piping remained in active service until 1991. There are no documented instances of leakage from the tanks, although there are anecdotal reports that diesel fuel was spilled during refueling operations on occasion.

TAN-738 was taken out of service in September 1991 and the transfer line was modified to allow the boilers in TAN-641 to be fed directly from Tank TAN-787. When taken out of operation, the condition of tank TAN-738 was deteriorated but the tank still contained oil, which was transferred into tank TAN-787. During a startup test of the boilers in October 1991, an estimated 7,949 to 13,627 L (2,100 to 3,600 gal) of diesel fuel was unaccounted for. It was suspected that either transfer line was leaking, or the boiler meters were not functioning properly. A pressure leak test indicated a portion of the transfer piping was leaking. Tank TAN-787 was not suspected of leaking because tank gauge measurements appeared to be accurate, based on the changes measured during the transfer of oil [in 208-L (55-gal) drums] from TAN-738 to TAN-787. During excavation of the transfer line, the soil below the piping appeared discolored and smelled strongly of petroleum products, although only three small holes were found in the piping itself. Soil sampling and analysis indicated substantial soil contamination below the pipeline.

Tanks TAN-738 and TAN-787 were removed in December 1991. When removed, TAN-738 contained numerous small holes, and soil below the tank both smelled and appeared contaminated with diesel fuel. Analytical results for samples collected from the tank excavation indicate diesel fuel contamination is present in the soils below the excavation. When TAN-787 was removed, the excavation appeared contaminated, although photoionization detector readings only ranged from 0 to 310 ppmv on the samples taken from the excavation. Analytical results for the excavation soil samples indicate diesel fuel contamination in the soils (Blackmore 1994).

4.1.15.2 Previous Investigations. In 1994 a Track 2 investigation was conducted to determine the types and concentrations of potential contaminants at the site and to establish whether the contaminants were migrating along pathways of potential concern (Blackmore 1994). In May 1994, 55 passive soil vapor collection devices were placed 49.7-cm (18-in.) bgs in and around WRRTF. The results of the analyses of the vapor samplers indicate that in the shallow soils, to approximately 9.1 m (30 ft) bgs, the distribution of fuel oil contamination may be restricted to the area near the fuel oil transfer line. On the basis of the results of the soil vapor survey as well as the 1990 and 1991 tank and pipeline excavation sampling and analysis results, three boreholes were drilled to the soil and basalt interface to characterize the vertical extent of contamination at the site. The borings were placed near the 3.8-cm (1.5-in.) transfer line, and at the former locations of tanks TAN-787 and TAN-738. Samples were collected at 0.6-m (2-ft) intervals for field screening. Samples from selected intervals, including the first, last, and most contaminated (based on field screening results), were sent to a laboratory for CLP VOCs, SVOCs and total petroleum hydrocarbon (TPH) analyses. The intervals sampled for laboratory analysis in each borehole are summarized in Table 4-21.

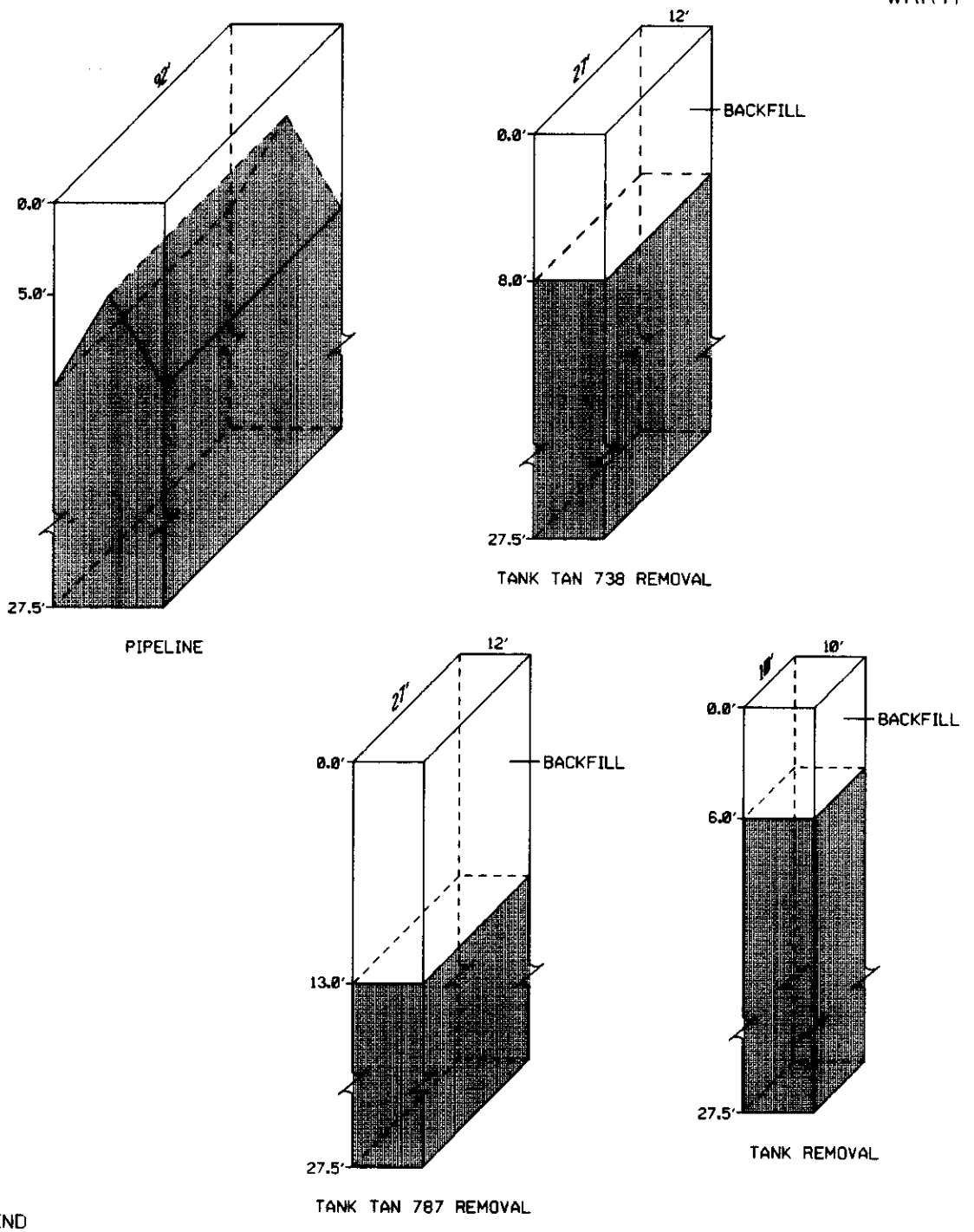
During both field screening and laboratory analysis, contamination was detected in all sample intervals in the three boreholes drilled during the Track 2 investigation (see Figure 4-41). Xylene was detected in six of the 10 samples collected at concentrations ranging from 20 to 77 mg/kg. Ethylbenzene was detected in the samples collected from Boring No. 3 at concentrations ranging from 1.8 to 4.9 mg/kg. In the SVOC analysis, primarily contaminants that would be associated with diesel fuel were detected: naphthalenes, acenaphthene, anthracene, fluoranthene, phenanthrene, pyrene, and fluorene.

Table 4-21. Intervals sampled for laboratory analysis in each borehole.

Sampling Event	Borehole ID	Sample Interval (ft)	Sample ID	Notes
1994 Track 2	787	12 to 14	1TB52601	First interval below depth of 1991 tank excavation.
		24 to 26	1TB53201	
		26 to 27	1TB53301	Last interval before basalt interface.
	3	6 to 8	1TB54001	First interval below depth of excavated pipeline.
		22 to 24	1TB54801	
		28 to 30	1TB55101	Last interval before basalt interface.
	738	8 to 10	1TB51001	First interval below depth of 1991 tank excavation.
		12 to 14	1TB51201	
		34 to 36	1TB52301/02	Last interval before basalt interface.

2-methylnaphthalene was most consistently detected at the highest concentrations, ranging from 48 to 290 mg/kg. In the VOC and SVOC analyses, many TICs associated with petroleum fuel were detected including paraffins, benzene compounds, and naphthalenes. The estimated concentration of the TICs detected ranged from 31 to 700 mg/kg. The TPH concentrations in the 10 samples ranged from 3,200 to 35,700 mg/kg (LMITCO 1995).

The 1996 RI sampling is discussed in Section 3.5. The results of the laboratory analysis of seven samples collected from three boreholes during the RI, are discussed in this section. TPH was detected in low concentrations (4.6 to 3,080 mg/kg) in all of the collected samples. Other VOCs and SVOCs were detected only in the two samples collected from the 6.5 to 7.3 m (21.5 to 24 ft) and 8.1 to 8.2 m (26.5 to 27 ft) intervals in Borehole No. 3. The analytical results confirm the results of field screening performed during sampling that indicated contamination was limited to below 5.5 m (18 ft) in Borehole No. 3. The compounds detected include phenanthrene, anthracene, pyrene, ethylbenzene, xylene, indeno(1,2,3-cd)pyrene, naphthalene, fluorene, fluoranthene, and 2-methylnaphthalene at concentrations ranging from 50 to 20,000 µg/kg. A complete set of the analytical results is included in Appendix A and the COPCs identified from the contaminant screening process detailed in Section 6 are summarized in Table 4-22 below.



NOTES:

(1) The following COPCs were identified but do not have toxicity values: 2-methylnaphthalene, phenanthrene, pthalate (TIC) and TPH. Concentrations are presented on Table 4-22.

Figure 4-41. WRRTF-13 nature and extent assumptions.

Table 4-22. Summary statistics for WRRTF-13.

COPCs	Concentration (mg/kg or pCi/g) Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
2-Methylnaphthalene	13	290	6.23E+01	7.86E+01	20	12	60%	—	NA
Phenanthrene	4.8	37	8.06E+00	1.04E+01	28	14	50%	—	NA
Phthalate	0.1 JN	0.2 JN	1.75E−01	5.00E−02	4	1	25%	—	NA
TPH	4.6	35700	9.15E+03	9.99E+03	18	18	100%	—	NA

J = Estimated.

N = Spiked sample recover not within control limit.

4.1.15.2.1 Nature and Extent of Contamination. Based on the sampling results, although different analytical techniques were used during the 1990 to 1991 sampling events and the 1994 to 1996 sampling events, similarities and differences between the individual data sets can be seen, including the following:

- Benzene was not detected in any of the 41 samples collected, and concentrations of ethylbenzene were very low or nondetectable in all sampling events.
- The TPH was consistently detected at higher concentrations than the other analyzed contaminants.
- Concentrations of toluene, generally very low or nondetectable, were much higher in the samples collected from below the transfer piping in 1991, perhaps indicating more recent contamination, such as the 6,426-L (3,600-gals) of fuel lost turning the boiler startup testing.
- Concentrations of all contaminants appear lower below TAN-739. This may be a result of the removal of 24.5 m^3 (32 yd^3) of contaminated soil prior to sampling and indicates that contamination below TAN-739 may decrease with depth. Concentrations of contaminants detected in the contaminated region in Borehole No. 3 in 1996 are also lower, perhaps as a result of the increased distance from the contamination source, which is the small holes in the transfer piping.

The results of the Track 2 and RI borehole sampling appear roughly consistent with the results of the 1994 soil vapor survey, and indicate that more than one source of diesel fuel contamination exists at the site. Each tank and the transfer piping represent a discrete source of contamination. The contaminated soil volume of 705 m^3 (952 yd^3) was calculated by assuming that the contamination is evenly distributed below the approximately 28 m (92 ft) of piping in which holes were found in 1991. The sampling and analysis results for Borehole No. 3 drilled in 1996, suggest a cone of contamination below the pipeline extending out approximately 3 m (10 ft) on either side at the basalt interface.

Because the soil vapor survey results do not indicate extensive contamination below the three removed tanks, the contaminated regions below these tanks are assumed to be localized directly below the tanks. If it is assumed that the contaminated region below the tanks is a block extending one tank width beyond the tanks on each side, then the volume of contaminated soil would be 642 m^3 (839 yd^3). The contaminants detected at the site during the various sampling events are phenanthrene, acenaphthene, anthracene, pyrene, ethylbenzene, xylene, indeno(1,2,3-cd)pyrene, naphthalene, fluorene, fluoranthene, and 2-methylnaphthalene. TPH and phthalate, both qualitative parameters, have also been detected. Figure 4-41 shows the assumptions for the nature and extent of contamination as well as the source-term estimates for WRRTF-13.

The COPCs for WRRTF-13, based on the contaminant screening process detailed in Section 6 and Table B-29, are shown in Table 4-22. None of these contaminants have accepted toxicity data, so they are not evaluated quantitatively in the BRA.

4.1.16 TSF-36, TAN-603 French Drain

4.1.16.1 Site Summary. TSF-36 is the former site of a french drain that was located approximately 6 m (20 ft) west of TAN-603, as shown in Figure 4-42. The drain was a 0.9-m (3-ft) concrete conduit,

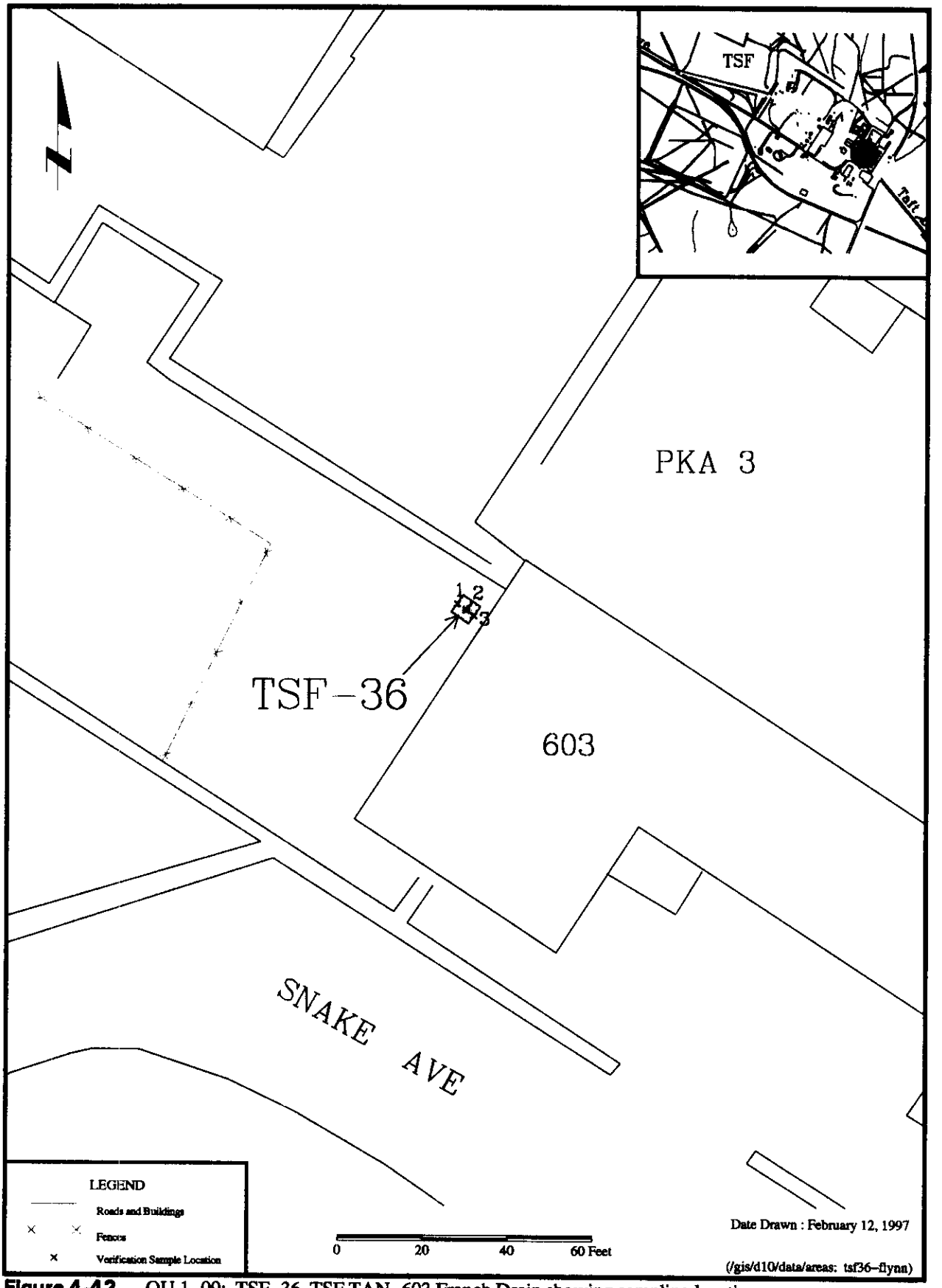


Figure 4-42. OU 1-09: TSF-36, TSF TAN-603 French Drain showing sampling locations.

which was placed vertically in the ground and rose to approximately 0.3 m (1 ft) above ground level. The depth of the conduit was estimated at 0.9 m (3 ft) bgs. The french drain was connected to a steam line in TAN-603 via a pipe that entered TAN-603 from the northwest corner. Also located at the northwest corner of the building was a flash tank that was connected by piping to a condensate return sump in the floor of the boiler room at TAN-603. The flash tank was used as an evaporator to remove excess steam from the boiler system. A hose from the drain valve on the flash tank allowed water to flow from the flashtank to the french drain. The valve drain was sealed in the late 1980s. Approximately 0.6 m (2 ft) from the flash tank, a radioactively contaminated roof drain exited the northwest corner of the building. Another roof drain was located on the west wall of TAN-603. Both roof drains were equipped with splash blocks. Both roof drains were located upgradient of TSF-36 to allow rainwater to flow from the splash blocks to the french drain.

The french drain reportedly received boiler water produced during normal boiler operations from the early 1950s until the late 1980s. The wastewater may have been contaminated with diesel fuel that leaked from the boilers during operation. In 1961 a leak developed in the TAN-616 evaporator system, which was used to concentrate radioactive liquids from the TSF-09 V-tanks. The evaporator lines, which were also part of the condensate return system inside building TAN-603, were also leaking. The leak in the evaporator system in TAN-616 allowed 3.78 L (1 gal) of radioactively contaminated water to enter the sump in TAN-603, which ultimately released to the french drain.

4.1.16.2 Previous Investigations. The french drain was initially sampled in May and August 1993. Cs-137 and VOCs were the suspected contaminants given the operational history. The August 1993 samples were collected from the upper 1 m (3 ft) of the drain, which encompassed the suspected contaminants, and analyzed for VOCs; SVOCs; metals; and alpha-, beta-, and gamma-emitting radionuclides. Several VOCs were detected but attributed to laboratory contamination. Chrysene and pyrene were also detected in the SVOC analysis. Detected inorganics included beryllium, copper, mercury, nickel, lead, and zinc. Cs-137 activity was also elevated.

Based on the evidence of contamination, the TSF-36 french drain was targeted for removal in November 1994. Prior to the TSF-36 french drain removal, a borehole was drilled through the french drain and characterization samples were collected from 0.6 to 1.5 m (2 to 5 ft), 1.7 to 2.3 m (5.5 to 7.5 ft), and 2.4 to 2.7 m (8 to 9 ft) bgs. The 0.6 to 1.5 m (2 to 5 ft) bgs sample was analyzed for gamma radiation. The 1.7-to-2.3-m (5.5-to-7.5-ft) bgs sample was analyzed for gross alpha and beta, metals, VOCs, SVOCs, gamma-emitting radionuclides, and TPH-diesel. The 2.4-to-2.7-m (8-to-9-ft) bgs sample was analyzed for gamma-emitting radionuclides. No evidence of contamination was observed in these samples.

Once the characterization samples were collected, the excavation of the TSF-36 french drain was initiated using a backhoe to remove the french drain culvert and contaminated soil. The final excavation was approximately 2.1 to 2.4 m (7 to 8 ft) deep and approximately 2.7 to 3.4 m (9 to 11 ft) in diameter. A VOC and radiation survey of the excavated area indicated the area was at background. An additional characterization sample was collected from the pile of excavated soil and analyzed for TCLP metals, VOCs, and SVOCs to determine waste disposal options.

Following the removal of the french drain and the contaminated soil, a verification sample was collected from each of the following locations, the bottom center and the east side and west side of the bottom perimeter of the excavated area. The depth of the samples was approximately 2.1 to 2.4 m (7 to 8 ft) bgs. The excavation was then backfilled with clean fill material. All three verification samples were analyzed for the same compounds detected in the initial investigation samples collected in 1993. Therefore,

the verification encompassed the potential contaminants for the site [i.e., gamma-emitting radionuclides (Cs-137), gross alpha and beta radionuclides, VOCs, SVOCs, metals, and TPH-diesel].

The results from the gamma spectrometry analysis on the verification samples showed that Cs-137 was the only gamma-emitting radionuclide detected. Cs-137 was detected below the background concentration of 0.46 pCi/g in the bottom center sample. Benzo(a)pyrene, benzo(g,h,i)perylene, and pyrene were detected in the verification samples at concentrations of 110, 360, and 67 mg/kg, respectively. Metals were also detected at concentrations similar to background levels in all three verification samples. TPH-diesel was only detected in the center sample at a concentration of 174 mg/kg, which is consistent with the SVOC concentrations observed.

4.1.16.3 Nature and Extent of Contamination. Based on the sampling results, benzo(a)pyrene is the only chemical-specific COPC for the site. A summary of the benzo(a)pyrene results is presented in Table 4-23. Along with TPH concentrations, benzo(a)pyrene was detected in the native soil at the base of the excavation. Since benzo(a)pyrene was not detected in the verification samples from the sidewalls of the excavation, the affected area is limited to the bottom center of the excavation. Assuming a radius of half the distance to the sidewall samples, 1.5 m (5 ft), the affected area is 7 m^2 (78.5 ft^2). Based on the fact that benzo(a)pyrene is a relatively immobile compound, the depth of contamination is conservatively estimated at 0.9 m (3 ft) below the center sample as shown in Figure 4-43. Figure 4-43 also shows the assumptions for the nature and extent of contamination as well as the source-term estimates for TSF-36.

The COPCs for TSF-36, based on the contaminant screening process detailed in Section 6 and Table B-24, is shown in Table 4-23.

4.1.17 OU 1-09: TSF-37, Contaminated Well Water Spill

4.1.17.1 Site Summary. TSF-37 is the site of a 83,160-L (22,000-gal) spill of contaminated groundwater in 1988, as shown in Figure 4-44. The water was produced during purging and sampling of the TSF-05 injection well in January 1988. The purge water was stored in a 189,000-L (50,000-gal) aboveground storage tank (AST) located near the TSF sewage treatment plant. The spill was a result of freezing and thawing, which caused the tank drain valve to crack. As discussed in Section 4.1.12, the injection well was used historically to dispose of organic sludges, to treat sanitary sewage, and to process wastewaters and low-level radioactive waste streams. The well was last used in 1972. The injection well and surrounding groundwater contamination are subject to a remedial action.

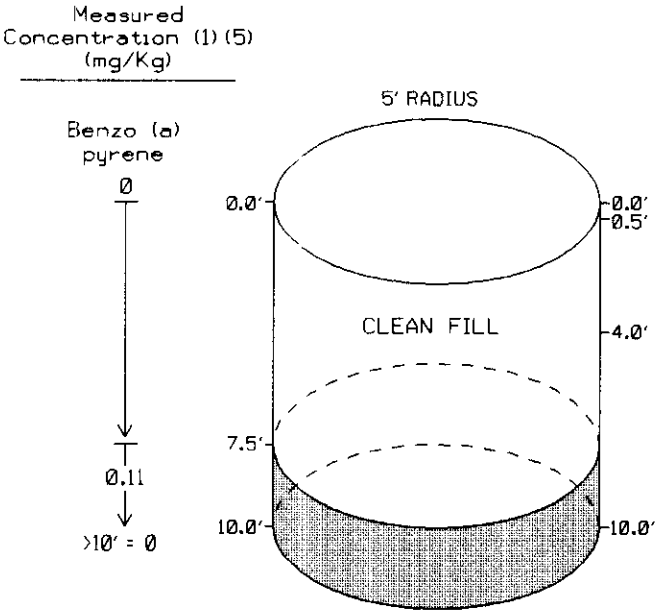
The primary contaminants associated with the TSF-05 injection well and surrounding contaminated groundwater are tricholoroethylene, tetrachloroethylene, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, Cs-137, and Sr-90. As a result, these contaminants are the suspected contaminants for the TSF-37 contaminated well water spill.

The contaminated well water spill was discovered in March 1988, and at that time all but approximately 265 L (70 gal) of the water in the tank had drained out onto the ground. The remaining water in the tank was recovered, sampled, and disposed. Approximately 0.3 m^3 (1 ft^3) of the soil below the drain valve was also removed because of elevated field radiation measurements. The sample of the recovered water from the tank was analyzed for Sr-90, tritium, and gross alpha and gross beta radionuclides prior to disposal. For all of the analytes, the results were statistically negative.

Table 4-23. Summary statistics for TSF-36.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Benzo(a)pyrene	0.11 J	0.11 J	1.33E+00	2.61E+00	5	1	20%	—	NA
TPH as diesel fuel	174	174	6.63E+01	7.18E+01	4	1	25%	—	NA

J = Estimated.



Exposure Point Concentration (2) (mg/Kg)		
Receptor/Pathway	Depth	Benzo (a) pyrene
Occ (3) - Air	Ø-0.5'	Ø
Occ (3) - External Rad.	Ø-4'	Ø
Res (4) - All	Ø-10'	Ø.Ø33
Res (4) - Groundwater	Ø>10'	Ø.Ø33

LEGEND

Zone of contamination for Benzo(a)pyrene.

ASSUMPTIONS:

- 1.52 m (5 ft) radius of influence assumed. COPCs detected only in the center of the excavation.
- Site has been excavated to 2.29 m (7.5 ft) bgs and backfilled with clean soil.
- Benzo(a)pyrene detected at 110 ug/Kg in one of three verification samples.
- Contamination conservatively assumed from 2.29 m (7.5 ft) to 3.05 m (10 ft) bgs because of the relative immobility of benzo(a)pyrene (a semivolatile organic) in the environment.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

(5) TPH-diesel was identified as a COPC but does not have a toxicity value. Concentrations are presented on Table 4-23.

Figure 4-43. OU 1-09: TSF-36, TAN-603 nature and extent assumptions.

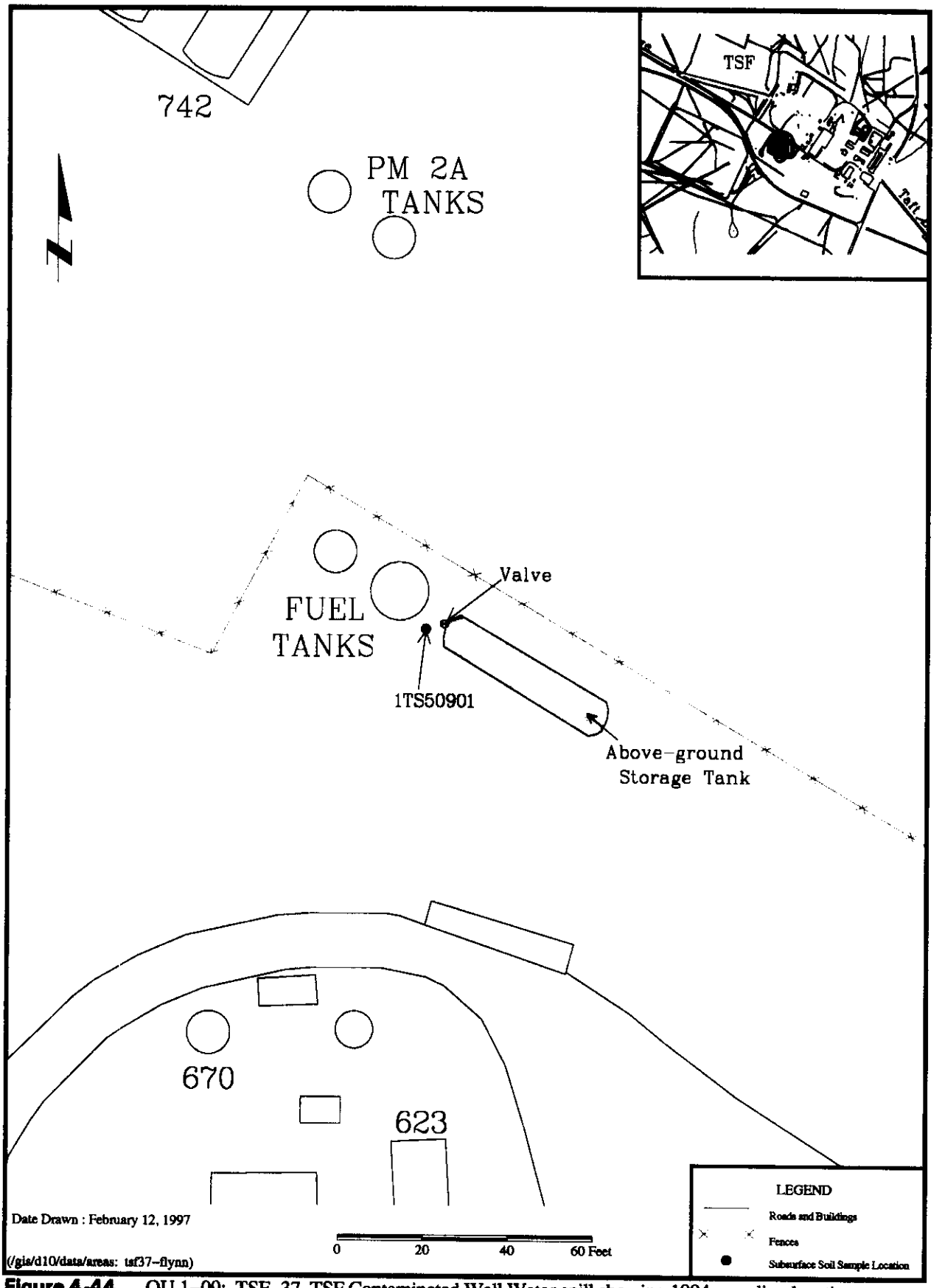


Figure 4-44. OU 1-09: TSF-37, TSF Contaminated Well Water spill showing 1994 sampling location.

Sample results from the 1988 groundwater sampling indicated that the contaminated well water likely contained trichloroethylene and trans-1-2-dichloroethylene and low levels of chloroform, 1,1,1-trichloroethane, tetrachloroethylene, toluene, 1,1-dichloroethane, 1,1-dichloroethylene, 1,2-dichloroethane, benzene, ethylbenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, vinyl chloride, and xylenes.

4.1.17.2 Previous Investigations. In 1993, as part of the Track 1 investigation, a shallow boring was placed approximately 0.6 m (2 ft) west of the drain valve. The soil was surveyed for radiological contamination and screened for VOCs. Neither radioactivity nor VOCs were detected.

Track 2 field activities at TSF-37 were conducted in July 1994. Two soil samples (one surface, one soil boring) were collected at approximately 1.1 m (3.5 ft) southwest of the AST drain valve. Approximately 35 cm (14 in.) of gravel was removed prior to the collection of the surface soil sample. Following the collection of the surface sample, the boring was advanced to a depth of 1.5 m (5 ft) using a hand auger, and a second sample collected.

The samples were analyzed for gamma-emitting radionuclides, Sr-90, H-3, Am-241, plutonium and uranium isotopes, and VOCs. Cs-137, the only gamma-emitting radionuclide detected in any of the samples, was below the background activity of 1.28 pCi/g with an activity of 0.78 ± 0.08 pCi/g in the surface sample. Sr-90 was also detected in the same sample at 1.2 ± 0.2 pCi/g, which is slightly elevated with respect to the 0.76 pCi/g background concentrations. H-3 was detected at 1.8 ± 0.5 pCi/g. Below background activities of U-234 and U-238 were detected in both of the soil samples collected. Am-241, U-235, and plutonium isotopes were not detected in the samples.

The results indicated methylene chloride and acetone at estimated concentrations of 1 and 10 μg/kg, respectively. While methylene chloride and acetone are identified in the contaminant screen in Section 6, they were not detected in the 1988 groundwater sampling that generated the spilled water. Furthermore, methylene chloride and acetone are both generally considered common laboratory contaminants. As a result, neither chemical is suspected to occur as a potential contaminant at TSF-37.

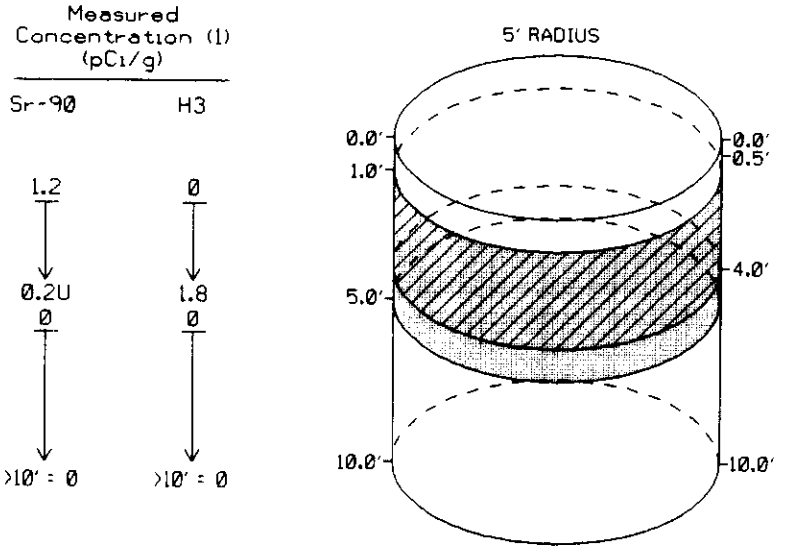
The analytical suite employed for the TSF-37 sampling program was sufficient to characterize the suspect contaminants given the primary contaminants for TSF-05.

4.1.17.3 Nature and Extent of Contamination. Soil sampling results at TSF-37 indicate low levels of Sr-90 and H-3 are present in the shallow soil at the site. This is consistent with the COPCs identified in Section 6. Concentrations of Sr-90 drop to nondetect values at the 1.2-to-1.5-m (4-to-5-ft) depth while tritium is detected at 1.8 pCi/g. Figure 4-45 shows the assumptions for the nature and extent of contamination as well as source-term estimates for TSF-37.

The COPCs for TSF-37, based on the contaminated screening process detailed in Section 6 and Table B-25, are shown in Table 4-24.

4.1.18 OU 1-10: LOFT-12, Transformer Yard #2 PCB Spill Site

4.1.18.1 Site Summary. LOFT-12 is in the north transformer yard located north of the Contained Test Facility (CTF), TAN-650, as shown in Figure 4-46. LOFT-12 includes previously fenced yard area approximately the 9.1 to 12.2 m wide by 15.2 m long (30 to 40 ft by 50 ft), and the adjacent unfenced area approximately 4.6 m wide by 9.1 m long (15 ft by 30 ft), immediately east of the yard. The transformer yard was used from the early 1970s to 1994 to provide power to the CTF and adjacent buildings. The



Exposure Point Concentration (2) (pCi/g)			
Receptor/Pathway	Depth	Sr-90	H3
Occ (3) - Air	Ø-0.5'	Ø	Ø
Occ (3) - External Rad.	Ø-4'	0.9	Ø
Res (4) - All	Ø-10'	0.37	0.18
Res (4) - Groundwater	Ø>10'	0.37	0.18

LEGEND

Zone of contamination for Sr-90.

Zone of contamination for H3.

ASSUMPTIONS:

- 1.52 m (5 ft) potential radius of influence based on slightly elevated Sr-90 at 1.07 m (3.5 ft) radius from spill area.
- Ø m (Ø ft) to .31 m (1 ft) bgs interval is assumed Ø concentration because Ø m (Ø ft) to .36 m (14 in) of soil was removed prior to sample collection.
- The zone of contamination for Sr-90 is assumed from .31 m (1 ft) to 1.22 m (4 ft) bgs based on sample results from the .31 m (1 ft) to .61 m (2 ft) bgs and 1.22 m (4 ft) to 1.52 m (5 ft) bgs intervals.
- The zone of contamination for H3 is assumed to be limited to the 1.22 m (4 ft) to 1.52 m (5 ft) bgs interval, based on one detect.
- 1.52 m (5 ft) to 3.05 m (10 ft) bgs interval assumed Ø concentration because Sr-90, the only COPC above background, is nondetect (i.e. Ø.2 U) at the 1.22 m (4 ft) to 1.52 m (5 ft) bgs interval.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-45. OU 1-09: TSF-37, Contaminated Well Water Spill, nature and extent assumptions.

Table 4-24. Summary statistics for TSF-37.

	Concentrations (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
H-3	1.8 +/– 0.5	1.8 +/– 0.5	9.00E–01	1.04E+00	4	2	50%	—	NA
Sr-90	1.2 +/– 0.2	1.2 +/– 0.2	6.50E–01	7.78E–01	2	1	50%	0.76	1

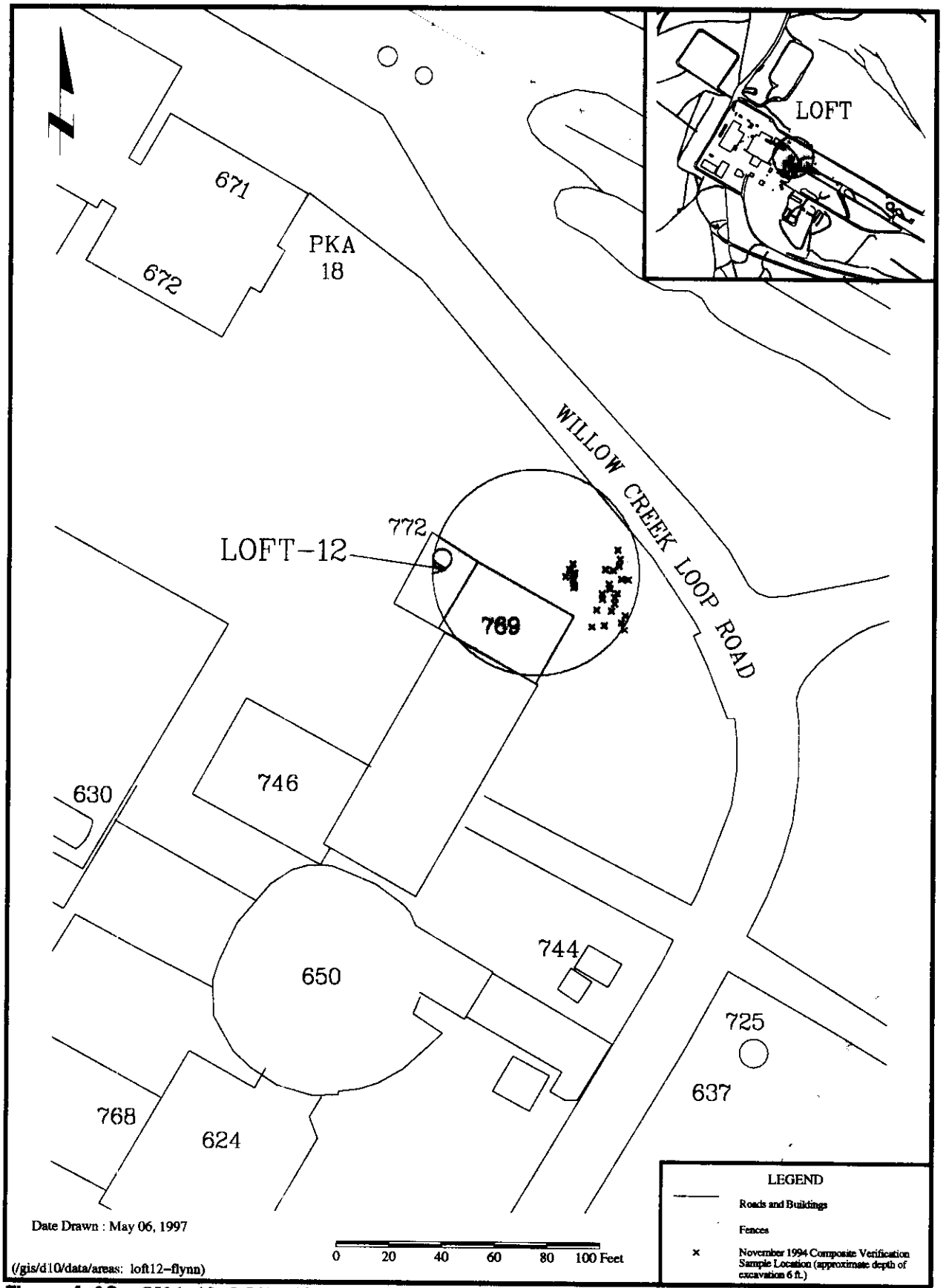


Figure 4-46. OU 1-10: LOFT-12, North Transformer Yard No. 2 PCB Spill Site, 1994 sampling locations.

adjacent east area is not known to have been used to store hazardous or radioactive materials. During an inspection of INEELs transformer yards in 1989, PCB contamination was identified on one of the transformers at LOFT-12. Sample results revealed PCB contamination greater than the 10 ug/100 cm^2 which is the 40 CFR 761.125 clean up value. Additional soil and concrete sampling was conducted between August and October 1989 to assess the extent of contamination.

4.1.18.2 Previous Investigations. Analysis of the soil and concrete samples indicated that 13 of 91 samples contained PCB values above the Toxic Substances Control Act (TSCA) regulatory limits of 25 ppm for soil and 10 ppm for concrete. Apparently, PCB-contaminated oil had leaked onto the eastern concrete pad, into the soil adjacent to the north and east edges of the eastern pad, and into the soil adjacent to the north edge of the western pad. Analysis of soil samples indicated PCB values ranging from 29 to 110 ppm, while analysis of concrete samples indicated PCB values ranging from 19 to 4,058 ppm. Between 1988 and 1989, all transformers containing PCB-contaminated oil were either removed and replaced with transformers containing a non-PCB, or were drained and retrofilled with non-PCB oil.

In 1994 a maintenance action removed approximately 186 tons of PCB-contaminated materials, including soil, concrete, steel reinforcement bars, and the remaining five transformers. Subsequent soil sampling in November 1994 (Figure 4-41) indicated that the formerly contaminated areas were below 2 ppm PCBs (Aroclor-1260) at depths of 0.3 to 1.8 m (1 to 6 ft) bgs. In addition to PCB sampling, LOFT-12 was surveyed for radioactive contamination and three surface composite soil samples were taken. No gross alpha or beta radionuclides were detected from the survey and results from the soil analyses indicated Cs-137 levels were below the background concentration (1.28 pCi/g). The excavated area was backfilled in March 1995.

4.1.18.3 Nature and Extent of Contamination. Following the excavation and removal of PCB-contaminated materials from LOFT-12, confirmatory sampling indicates that PCB concentrations are less than 2 ppm at a depth of 0.3 m to 1.8 m (1 to 6 ft). The area excavated was approximately 9.1 by 18.3 m (60 by 30 ft) and ranged from 0.3 to 1.8 m (1 to 6 ft) in depth. The residual PCB levels were determined to be acceptable with respect to TSCA standards.

Based on the sampling results, it is assumed that the site has 0.3 m (1 ft) of clean backfill from the previous maintenance action. The vertical extent of contamination is assumed to be to a depth of 1.8 m (6 ft) at the northwest end of the site, and 1.2 m (4 ft) at the southeast end of the site. The total volume of contaminated soil is estimated to be 130 m^3 (4,600 ft^3). Figure 4-47 shows the assumptions for the nature and extent of contamination and source-term estimates for LOFT-12.

The COPCs for LOFT-12, based on the contaminant screening processing detailed in Section 6 and Table B-3, is shown in Table 4-25.

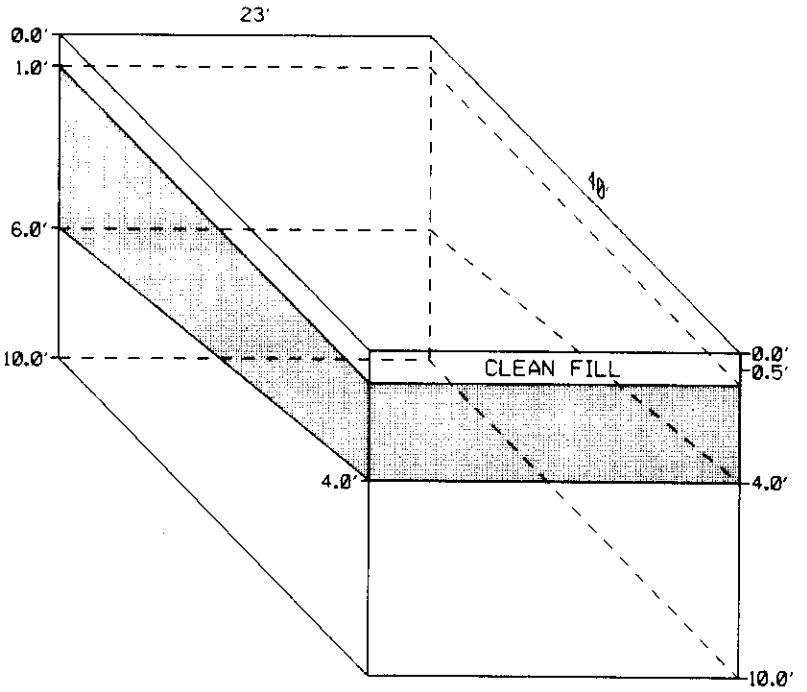
Measured Concentration (1) (mg/Kg)

Aroclor-1260

1.308

Ø

>10' = Ø



Exposure Point Concentration (2) (mg/Kg)		
Receptor/Pathway	Depth	Aroclor-1260
Occ (3) - Air	Ø-0.5'	Ø
Occ (3) - External Rad.	Ø-4'	0.9806
Res (4) - All	Ø-10'	0.6538
Res (4) - Groundwater	Ø>10'	0.6538

LEGEND

Zone of contamination for Aroclor-1260.

ASSUMPTIONS:

- The area and zone of contamination determined from post-removal composite verification samples.
- The zone of contamination ranges from .31 m (1 ft) to 1.22 m (4 ft) bgs and .31 m (1 ft) to 1.83 m (6 ft) bgs to account for variable depths of the removal action.
- Site was backfilled with a minimum of .31 m (1 ft) of soil.

NOTES:

(1) The measured concentration represents the 95% UCL or maximum concentration from sampling results and the assumed extent of contamination.

(2) The exposure point concentration represents the volume-weighted concentration for use in the BRA given the exposure route depth of interest.

(3) Occupational Scenario.

(4) Residential Scenario.

Figure 4-47. OU 1-10: LOFT 12, North Transformer Yard Spill and Soil Site, nature and extent assumptions.

Table 4-25. Summary statistics for LOFT-12.

	Concentration (mg/kg or pCi/g)								
COPCs	Minimum Detected	Maximum Detected	Arithmetic Mean	Standard Deviation	Number of Samples	Number of Detects	Frequency of Detection	INEEL Background (mg/kg or pCi/g)	Number of Samples Greater than Background
Aroclor-1260	0.18	1.9	5.26E−01	7.63E-01	7	7	100%	—	NA